TOUCH READING OF THE BLIND

BÜRKLEN

MERRY

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TOUCH READING OF THE BLIND

BY

KARL BÜRKLEN

Also Minor Articles on the Psychology of Blindness
by Paul Grasemann, Ludwig Cohn, Wilhelm Steinberg

TRANSLATED BY

FRIEDA KIEFER MERRY, PH.D.

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TRANSLATOR'S PREFACE

It is the purpose of this translation to acquaint progressive teachers of blind children with the numerous problems inherent in the mechanics of finger reading, and to stimulate graduate students and research workers, unfamiliar with the German language, to undertake investigations in this field. Those who are interested in the much debated question of a special psychology of blindness will find diametrically opposed discussions of this subject in the two concluding articles.

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FRIEDA KIEFER MERRY

Perkins Institution and Massachusetts School for the Blind
Boston, December, 1931

FOREWORD

A series of articles on the psychology of the blind which have appeared in the *Zeitschrift für angewandte Psychologie*[1] are presented herewith in monograph form so that they will be accessible to institutions for the blind, teachers of the blind, and oculists.

The bulk of the monograph is devoted to a description of the experimental investigations of the processes of touch reading made by Bürklen, director of the institution for the blind at Pürkersdorf, Vienna.

Of the minor contributions the article by Grasemann, a former teacher of the blind in Hamburg, at present director of the Institution at Frankfort, follows the main discussion and is intended to round out its point of view.

The lectures of Dr. Cohn and Wilhelm Steinberg are of a different nature. These writers represent the academically trained blind people who base their ideas about the psychology of blindness upon their introspections and personal experiences. As the writers represent obviously different ideals, this arrangement facilitates both points of view. While one tends to lessen as much as possible the gap existing between the blind and the seeing, the other purposely stresses the differences and claims the existence of personality types characteristic of blind people.

It seems to me that this contrast is in itself fundamentally psychological. Presumably, these writers belong to different types, both of which are well represented in the world of the blind. The existence of such diverse types as these can at present assume considerable importance in our understanding and treatment of the numerous war blind.

WILLIAM STERN

[1] Translator's Note. Edited by William Stern and Otto Lipmann.

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Part I

TOUCH READING OF THE BLIND

by

Karl Bürklen

TOUCH READING OF THE BLIND

CHAPTER I

History of Writing for the Blind

The knowledge that the fingers are the eyes of the blind led early to experiments in making the writing of the seeing tangible for those without sight. Letters cut from wood and made of wire were known in early times, but it was the art of printing which first made the embossing of a tangible script possible. In fact, about 1600, cursory researches were being made, but the first book of printing in relief for the blind did not appear until 1786. This book, *Essays on the Education of Blind Children,* was written by Valentin Haüy, founder of the Paris Institution for the Blind. It was embossed on damp paper, using special letters in low relief. At first Haüy chose for his embossing the capital and lower case letters of italic form which were in general use at the end of the eighteenth century, and he thus adhered to the common form of reading and writing (Figure I, No. 1. *See* illustration at end of book.)

In the first decade of the nineteenth century roman type was substituted for the italic forms because of its greater simplicity and tangibility. The capital letters of this type, originating with Haüy's successor, Pierre Dufau, still contained many unessentials, but the letters were being changed constantly to simpler forms (Figure I, Nos.3-5). With the technical establishment of roman print it became possible to differentiate the line (Nos. 2 and 5), the dotted (No. 3), and the pearl types (No. 4). These forms succeeded one another, and finally became obsolete with the abandonment of roman letters in the second half of the preceding century.

Teachers of the blind were not satisfied with the legibility of roman letters, and many experiments were made in an effort to simplify them. James Gall's runic script (Figure I, No. 6) represented a marked deviation from the roman, as the distinctive shapes made it very difficult to recognize the original characters. Moon type deviated even more from its predecessors (Figure I, No. 7), its characters not being legible to the seeing. Thus, a special script for the blind was worked out, although it adhered to simple and characteristic line forms.

The many problems involved in a perfect type for the blind were not thus solved. Experience with dotted and pearl types demonstrated the superior tangibility of punctographic embossing over that of the raised line type. This was borne out, also, by all other facts; hence it was necessary that

a script for the blind should be made up of dots. Furthermore, the lost unity of a reading and writing script would again be established by means of a generally used punctographic system.

L. Barbier, a Frenchman who was interested in telegraphy, first conceived and realized the idea of constructing a dot system for the blind. This not only could be read, but also could be written by means of a special slate which he invented. In the Paris Institution where his system had been introduced in 1821 it was discovered that this type presented too many details, but Louis Braille, one of the pupils, made an ingenious simplification which later became known as the "celebrated" braille type (Figure I, No. 8). After a long and bitter struggle against line type, it was finally adopted (between the years 1850 and 1870) as the universal system. (*16,* 1917, page 691.)

CHAPTER II

Braille Writing

The braille system of writing is composed of a group of six dots arranged as two perpendicular rows of three dots under one another, or as three horizontal rows with two dots beside each other. This six-dot system allows not only the possibility of an unlimited number of combinations, but also the comprehension of forms and, furthermore, is particularly suited to the sensitivity of the reading fingers on account of its rectangular shape. The dots are so numbered as to form two perpendicular rows; on the left dots 1-2-3, and on the right dots 4-5-6. Hence, in the horizontal rows the dots 1 and 4, 2 and 5, 3 and 6 appear across from one another.

1 ● ● 4
2 ● ● 5
3 ● ● 6

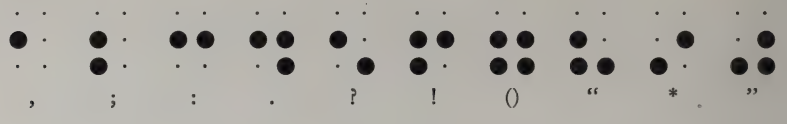
Of the possible combinations in which the top four dots could be used (separating those groupings which might lead to confusion) Braille chose the simplest for the first ten letters of the alphabet, A to J, which he called the fundamentals, since it was easy to make other forms from them. They are as follows:

By adding dot 3 (the lower left dot) to the basic forms a second row of letters, K to T, was obtained:

The rest of the letters of the alphabet (W is missing from the French characters) were made by adding both lower dots 3 and 6 to the basic characters:

And additional characters for accented vowels, umlauts, etc., were made by combining dot 6 (the lower right) with the fundamental forms.

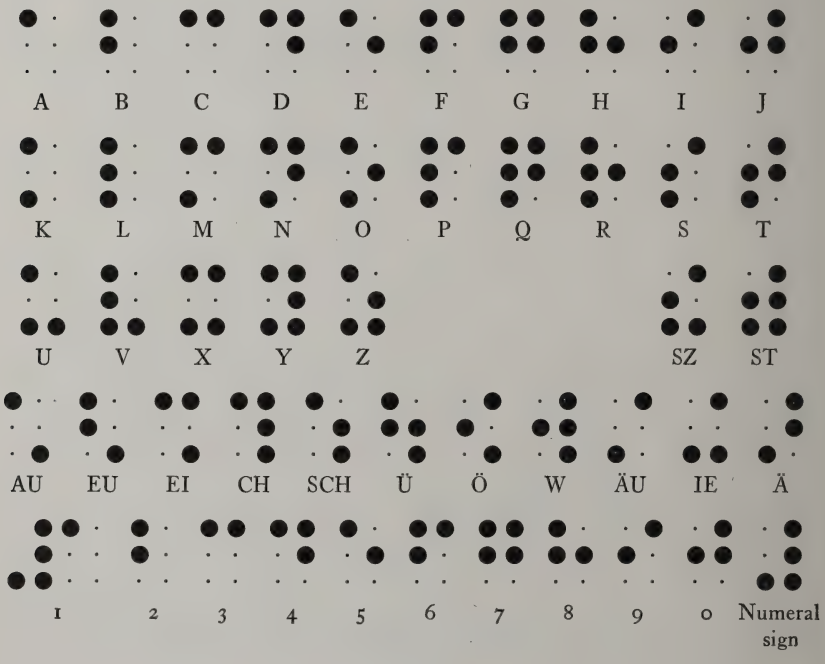
Finally, Braille converted the basic characters into punctuation marks by lowering them a row:

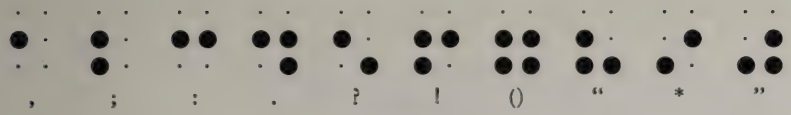


Again by prefixing a special sign the fundamental characters became numerals. When this number sign stood in front of a basic character, it indicated that it was no longer a letter of the alphabet, but a number:

Despite the fact that braille showed many deficiencies in practical use, the French forms were retained for the German alphabet because of their universality, and only such special characters were added to the letters as w, st, etc.

German Alphabet





Dash and hyphen

Apostrophe

There was also devised an omission sign by means of which an incorrectly written letter could be stricken out.

The greatest merit of braille, as contrasted with other systems of writing for the blind, lies in the ease with which it can be learned, its tangibility, and the simplicity of its characters. A knowledge of the fundamental and the derived forms is sufficient to learn it, since most of the other characters are made from the former.

The preceding alphabet is concerned only with full spelling, in which a character corresponds to each sound. However, braille permits of contractions—a kind of stenography. Braille characters also serve as symbols for musical notes. In our discussions we shall describe only the characters for full spelling.

CHAPTER III

Suitability of Raised Type for Touch Reading

"In contrast to the visual sense, which can discriminate between continuous lines and plane surfaces, the tactual sense differentiates the separate dot impressions," says Wilhelm M. Wundt. He mentions the history of writing for the blind as a "long story of the overcoming of prejudices which had their source entirely in a false analogy between the sense of sight and touch." As a matter of fact the development of a script for the blind proceeded from the line type of the seeing to its analysis into dots (pricked types), and thence to the arranging of punctographic characters, whose number of points do not exceed six (braille). Further practical developments did not take place, and were never encouraged or demanded scientifically.

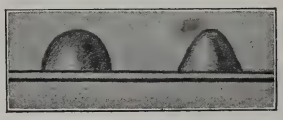


Illustration 1. Dots in Relief

The arrangement of six dots in a vertical rectangle by Braille can be regarded as ingenious. In his discussion of punctographic writing Wundt points out that "the span of attention with regard to the number of impressions simultaneously perceived is contained within narrow limits, since in general the maximum number of impressions which we can comprehend simultaneously with any of the spatial sense organs is six, be it eye or skin." He finds it "of special interest to note that Braille had hit (purely by accident) precisely upon the conclusions reached by research in psychological experiments." (*14,* II.B, pages 491 and 495.)

Also Theodore Heller (3) found through experimentation that by the use of six-point stimuli the best arrangement was three rows directly under each other with two dots in each. There can be no doubt as to the advantage of this arrangement when we consider that the attempted change to American Braille[1] (with the cell lying in a horizontal position) was not a

● ● ●
● ● ● success.

The dots are round, 1 mm. high, either in half spherical relief, or a somewhat conical pointed form. The conical form is considered more

[1] Translator's note. Probably means New York Point.

readable, since dots of this kind are not so easily pressed out as are the half spherical forms.

The size of braille characters was determined by experience. Large dots undoubtedly are more tangible, but since they destroy the unity of the letter, its comprehension as a whole is difficult. It is equally difficult to distinguish dots which are too small or too close together. As generally used, the following measurements may be considered as established: single dots have a diameter of 1.5 mm.; the tops of the dots are 3 mm. apart, so that the braille characters are 7 mm. long and 4.5 mm. wide. The space between adjacent characters is somewhat greater than the distance of the points from each other.

Concerning the size of the characters and the distance of the dots from each other, Wundt says: "The points stand at such distances that their spatial thresholds overlap on the ball of the index finger, while the points of a single character are found simultaneously within that space." (*14,* page 495.) Émile Javal found that the commonly used point characters are longer than the sensitive part of the index finger. (*5,* page 77.)

For the sake of economizing space in embossing, the introduction of smaller characters (6 mm. in length) has been urged many times (as is true even today) but has failed to become a general practice.

On this point Martin Kunz remarks: "For simultaneous comprehension a space (or diameter) under 2.5 mm. was too short (as in the small French type); it requires too much time in touch movements—since successive comprehension of the dots is necessary, making fluent reading impossible. For simultaneous comprehension more blunt dots having a diameter of 3 mm. are necessary for the blind." (*7,* page 188.)

The size of dot which is necessary to tangibility is such that point type calls for a disproportionately large amount of space as compared with inkprint. Indeed, this space is as much as ten times greater in the case of full spelling, as far as surface area is concerned. By the use of contractions the necessary space decreases to seven times that of inkprint. Each point character (together with the surrounding space belonging to it) requires 1 sq. cm. of surface. The elevation of point writing offers further disadvantages as does also the necessary strength of paper for embossing. Under favorable circumstances (contractions and interpointing) embossed books exceed inkprint books of equal content thirty times in volume. Under unfavorable conditions (full spelling and interlining) such books exceed the inkprint fifty times and more. (*16,* 1917, page 508.)

Although no final decision has been reached concerning the most useful size of braille characters, the special suitability of the arrangement of dots in a six-point field can be considered as established. Experience also has demonstrated that it is possible for blind children to learn to read braille in their first school year.

CHAPTER IV

The Organ for Reading

The hands[1] are the organs for touch reading, because the finger-tips possess special nerve endings which adapt them to this kind of reading. In feeling the punctographic letters, that touch surface on the ball of the finger is used which reaches from the middle of the so-called "touch rosette" to the arch under the finger-nail.

The area covered by light pressure of the finger-tips on the paper varies widely with the fingers of the same hand. With the index and middle finger, which play the chief rôle in reading, the touch span is actually greater for the latter than for the former. This difference is balanced, however, by the extra curving of the middle finger, resulting in the application of the same amount of touch surface of both fingers to the braille. Furthermore, the touch span of the reading finger differs according to the strength of the finger because of individual development depending on age and sex.

The form of the touch span is an oval, approaching a circle. As the position of the finger becomes more vertical, the touch span becomes less oval. It is assumed that it is always possible to cover the punctographic character of average size (7 mm. high and 4.5 mm. wide). The touch spans for readers eleven to nineteen years of age show a length of 6 to 18 mm. and a width of 6 to 12 mm., and these spans can, under these conditions, be less than the length of a letter. That is, it is not always possible for the younger readers to cover the characters fully with a light pressure of the finger-tips, so that in such cases a flat position of the finger or a stronger pressure appears to be necessary.

The angle at which the reading finger is placed against the paper is a sharp one. With the index fingers this angle is from twenty to thirty degrees. If the tips of the middle fingers are to remain on a level with those of the index fingers, they must be held somewhat more vertically so that the angle becomes somewhat greater. In touch reading the hands are held close to each other over the text in such a way that the reading fingers come into contact with the characters at the required angle, while the other fingers are curved lightly and remain at a slight distance above the page. One of the positions which is taken by the reading hands is shown in Illustration 2, page 11.

In general, the question as to whether the structure of the hand and

[1] It should be mentioned that, strange as it may seem, the blind can read also with the toes.

fingers is satisfactory for touch reading can be decided only in this way—that the most mobile of these organs should be given the preference. The innate organization of the tactual organs is conducive to touch reading, especially the tactual sensitivity of the finger-tips, while the outer structure (except in the case of deformities) seems to be of less significance. To attempt to select a special reading hand on the basis of structure is going too far and can lead only to a superficial and inaccurate choice.

With regard to the arm and body positions in touch reading, to which too little attention has been given previously, we can only say that the face of the book should be at such a height as to make possible a free and unhampered movement of the hands and also of the forearms. This freedom of movement is present only when the face of the book is not above the position of the elbows when the upper arm is held close to the body. (*16*, 1916, page 579.)

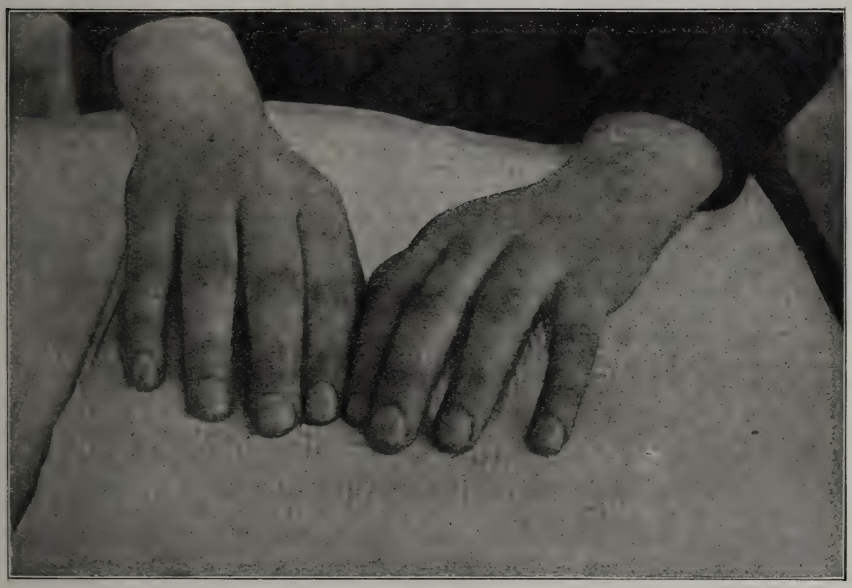


ILLUSTRATION 2. Left and Right Hands Held Close Together

CHAPTER V

The Process of Touch Reading

It is possible for a single punctographic character to be comprehended immediately as a whole through the pressure of one reading finger. In practice, however, such comprehension is present only when the finger, moving from left to right, glides over the individual letters. Generally, for the recognition of a single character a pressure of a finger-tip is usually not sufficient, but touch movements seem necessary.

Concerning this Javal says: "Even if a blind man is well practiced in braille reading, he will not always be able to tell the content, if his finger merely presses the dots. In order to recognize the dots and their arrangement, he must go back and forth over them with the finger, and this movement must be neither too fast nor too slow. Most blind people do not know that in order to read quickly their fingers must go over the dots with moderate pressure in order not to dull the sense of feeling." (*5*, page 8.)

With even more clarity Paul Hocheisen observed the touch movements of the reading finger. "In all directions over the letters the finger describes circles which are made by the wrist and the metacarpophalangeal joints. In addition, bending or stretching movements are made by means of the interphalangeal joints. The letter is touched with the same point of the finger-tips. By hindering these movements the comprehension of single letters becomes very slow; in fact, only the simplest letters generally are recognized." (*4*, page 33.)

The special touch movements produced by the blind had already been observed by Czermak in his studies of circles.

Hocheisen examined seven blind people and found only one case of touch twitchings such as those described by Czermak.

"These twitchings consisted of the following: The boy pressed his finger lightly on the dots, and with the dots as foci made random excursions which resulted in diverse stretchings of the skin. I am not clear about the purpose of these twitchings; they are involuntary and can not be suppressed."

Wundt offers the following explanation for these touch twitchings:

"Obviously, they are not primary reflexes, but seem to result from voluntary movements which are carried out for the most part by blind people engaged in finer work, and which become mechanical through practice so that they occur as reflex actions only when they are stimulated by outside tactual objects." (*14*, page 491.)

Czermak draws a comparison with eye reading:

"The touch twitchings of the blind are somewhat similar to the ocular adjustments of the seeing. When the latter want to observe an object distinctly, the axis of vision adjusts itself involuntarily to the object it wants to fixate in

order that the image may fall on the fovea. Similarly, the blind probably adjust their organs of touch by movements and twitchings."

On the basis of studies of tactual movements it is now recognized that touch is no simple process but a complex one, in which outer and inner sensations of touch play a part. Hocheisen says in this regard:

"The object in question comes into contact with the skin and produces an impression on it, as it were. Either the object can touch our skin with all of its points simultaneously, or its different surfaces can touch successively new sections of the skin. By the second method we touch new points of the object successively with the same point of the cuticle, mostly the finger-tips. According to the extent and direction of the movements executed by us, we judge the height and form of the object. . . . In this way we make use of space perception, pressure sense, and those abilities which are grouped under the heading of muscle sense. This is a transition to the second method mentioned above. The blind always use this method and resort to the first only when forced to do so. . . . Although nature has made space perception sufficiently acute so that it alone would be adequate for the requirements of reading, the blind do not make full use of the discriminatory sensitivity of their skin for reading. In the service of reading they employ, particularly, joint sensitivity, the basis of the perception of movement." (*4*, pages 31 and 34.)

The designations "synthetic" and "analytic" touch were introduced into the literature of the blind by Heller. He says in *Blindenfreund* (1905, page 4):

"The major portion of my *Studien zur Blindenpsychologie* is full of indications that synthetic touch (through the spatial sense of the skin) is not sufficient to provide the blind with adequate concepts. To this must be added touch with moving touch organs (analytic touch). According to my investigation, inadequate synthetic touch can create nothing more than a schematic general picture of small objects, which can only be interpreted by analytic touch movements."

When reading single characters, touch movements appear for which explanations already have been offered. In reading separate punctographic characters, touch movements become more extensive; while, on the other hand, they decrease with considerable practice.

According to this study the reading process is as follows: A line is read, the finger making many random movements in an effort to find the beginning, and after finding it, moving again over the letters (it is assumed that one finger only is used). Pauses, due to deviation from the reading direction, occur only in the case of characters which are difficult to recognize. Occasionally, the finger has to glide back to the beginning of an unrecognized word which the reader is trying to grasp as a whole. Javal states:

"The reading of complete words proceeds in such a way that a great number of characters are passed over; one guesses at them either by the total context, by the first letters of a word, or by the length of a word." (*5*, page 139.)

The most exact observations on the process of reading were made by Heller, and are described in the following way:

"In learning to read, the right hand usually is of greater importance. This hand carries out the characteristic reading movements, while the left hand takes over the task of locating the lines and of checking the accuracy of the initial points for the movement of the right hand. The movements in reading at first involve the whole arm. As soon as speed is attained, however, these movements are restricted to the forearm. Thus the forearm describes a circular movement, with the firmly held elbow as the fulcrum, the radius of which is equal to the line connecting the point at which the elbow is placed with the beginning and ending of the braille line. The horizontal projection of this circular movement is caused by the changing position of the reading finger which curves slightly more toward the middle of the line and straightens slightly toward the end of the line. The pressure of the under arm in reading obviously has the effect of supporting the reading finger completely so that it can give definite regulated pressure. The fingers that are not used in reading also act as a support, serving as the vehicle upon which the hand moves along. If a blind person has learned to read well, his left hand also shares in the reading process. However, this hand reads neither so rapidly nor so evenly as does the right. In this connection it is often observed that the arm changes its position by fits and starts. Because of the greater difficulties which naturally interfere with its movement, the left hand generally follows a slow analytical movement, while the right hand glides quickly over the line and supplies only a fleeting general concept of the individual characters." (*3*, page 87.)

"With those blind persons who are able to read fastest, twitching touch movements are not observed. The right and left hands glide quietly back and forth with fingers spread out over the lines, and the two hands differ with regard to comprehension only in the speed of their reading movements. Moreover, the participation of both hands is very different for different individuals. It sometimes happens that the two hands separate in the middle of the line (having moved together until then); the right moving forward to read the remainder of the line, the left finding the beginning of the next line.

"As a rule, analytic touch is discontinued by practiced braille readers. Only when compelled to spell out the letters because of unfamiliar words, well-worn characters or poor embossing, do they resort to analytical touch movements with their right hand." (*3*, page 92.)

The question as to which finger actually reads has not been answered clearly heretofore. According to previous assumptions one finger is very seldom used alone, both index fingers usually being applied, and in some cases the middle fingers, also. The rôle which is given to the reading fingers (a somewhat controversial subject) is clarified in the following:

"Reading is usually done with the two index fingers, with the forearms placed lightly on the page. The right hand glides lightly back and forth—not with a strong pressure—over the embossed letters for the purpose of recognition; the left for the purpose of control, that is, for comprehension or correction. But this is not invariably the rule. Attention, also, is called to the fact that the fluency of reading is determined by the method of touch reading employed. While the skilled finger glides back and forth over the whole words, the unskilled finger goes laboriously from one letter to another, showing a light rotary or a zigzag motion. For this reason alone it should not be asserted pedantically that the blind child should read only with the index fingers. It seems more sensible gradually to train all fingers for reading whenever possible (excluding the thumb perhaps)." (E. Gigerl, *9*, page 462.)

"In braille reading only the index finger participates. This is true even though the peculiar positions of the fingers of many blind people make it seem as if the other fingers took part in the recognition of the characters. In such cases this point can be demonstrated conclusively by excluding the reading finger and by forcing the subject to read with some other finger, for instance, the middle finger." (T. Heller, *3*, page 86.)

"Generally the blind use both index fingers for reading. The rapidly moving right finger takes care of the synthesis, while the more slowly moving left finger works analytically. With practiced readers synthesis and analysis come together (occur simultaneously); only in the case of indistinctly embossed characters is there a breaking up of the touch process." (F. Zech, *15*, page 122.)

"When a blind person reads, he places both hands on the paper, locates the points on the lines, and glides over the letters with both hands. During this reading many smaller movements occur with both hands. The fingers share in the reading in such a way that only one of them actually reads. If, for example, a blind person reads with the index finger of the left hand, he will lead the way with his right finger, and thus one finger plays the chief rôle. Through this process the blind mark off the individual words and obtain a superficial and general idea of them, thus making the task easier for each reading finger. The other fingers are used to locate the lines. For reading, the blind employ the index fingers mostly, but here, also, there are individual differences. The reading finger does not glide over the word as a unit but movements of all finger joints and of the wrists are used." (P. Hocheisen, *4*, page 32.)

"In the majority of cases reading is done with both index fingers. These as a rule show the more highly trained tactual sensitivity. Next to them come the middle fingers, which can become equally skilled; then the third fingers. The little fingers are seldom considered; likewise, the thumbs are usually neglected. Generally, the non-reading fingers are lifted slightly so that they do not rest on the letters. The blind read almost entirely with two fingers, of which one actually is doing the reading (!), while the other precedes or follows as a control finger (!). If both index fingers are employed, one blind person may read with the left, while the right acts as a control; whereas with another person the opposite may be the case. This is true, also, of the other fingers. The control finger confirms what the reading finger recognizes. Often it also has the task of making the transition to the next line (even if it is the right index finger?), or at least helping toward making the transition easier. There are different methods of finding the lines. Often both fingers go back on the line just read and then feel for the next line; the orienting finger finds the beginning of the next line while the reading finger is still passing over the last words. The blind who read only with one index finger leave the other finger at the beginning of the line and bring it down to the next as soon as the reading finger moves away from it." (A. Mell, *8*, pages 89 and 90.)

Javal thinks that the left index finger, despite its greater sensitivity, is used less than the right in reading. (*5*, page 7.)

"While reading braille (which, as you know, consists of dots) the blind person touches the characters with the fingers of one hand while the other hand feels one point after the other and associates these concepts of motions with the simple touch sensations, thereby attaining a spatial comprehension of the letters which enables him to read." (R. Schulze, *12*, page 70.)

The above descriptions show little agreement on the process of touch reading. This last citation of Schulze is an example of how easily people who have no practical knowledge of braille reading, accept such ideas.

CHAPTER VI

The Speed of Touch Reading

From what has already been said, it is obvious that the speed with which the blind are able to read braille with their fingers must be less than that of the eye in reading inkprint.

Concerning this Javal says: "The reading of braille is so slow because the finger can feel only one letter at a time, while the eye, on the average, takes in ten letters at a glance. It follows, therefore, that for physiological reasons, reading with the fingers is at least ten times slower than reading with the eyes." (*5*, page 64.) In another part of Javal's book is found the statement "five times." (*5*, page 72.)

Without question the comparative slowness of touch reading has its source in the limited capacity of the reading organ. Furthermore, in touch reading there is no indirect "feeling" comparable with that indirect vision which is so helpful in reading with the eyes.

Haüy who first made intensive observations on touch reading, says this about the speed of his students: "Our pupils of course read very slowly. Apart from the fact that they have had little practice in reading on account of the newness of our institution, they are at a disadvantage because they see only one letter at a time (if we may make use of this expression). It might be similar with our reader if he could see the letters of this book only through an opening." (*Essai sur l'Education des Aveugles*, 1786.)

Retardation is caused not only by the direct touching of each character, but also by the gliding from line to line. The latter leads to disturbing pauses in the case of unpracticed readers, making fluent reading impossible.

Skill in reading is a highly individual matter. It is furthered through special touch sensitivity of the reading finger, the mental ability of the reader, and his degree of attention, as well as through the practical size of the characters, the clearness of the embossing, and even the paper used in printing. A lessening of the speed of reading is shown in the case of fatigue (dulling of tactual sensitivity, a relaxing of the attention), or with too sharp or too worn down embossing, as well as with perspiration or with a chilling of the reading fingers.

Under the above circumstances it is difficult to determine the exact speed of reading. If Javal's assumption is accepted as a minimum limit, then the assertion of Kunz (*7*, page 193) that the best braille readers are almost as fast as the visual readers, may be regarded as the maximum.

Javal (*5*, page 71) quotes the performance of the librarian Demény as the best example of rapid touch reading. In the presence of Javal this man (Demény)

read aloud almost 200 words in a minute. "This speed," Javal maintains, "he attained only when he read with both index fingers. When, for instance, his right index finger came to the end of the line, the left already had probably reached the middle of the following line, so that the left finger was always ahead of the right in reading, while the right followed the spoken word."

Heller (*3*, page 95) examined only a few blind persons as to speed of reading. The following results were obtained from a two-minute reading period:

	In Two Minutes	In One Minute
Prose Text (Krummacher):		
Der blühende Weinstock	158 words	79 words
Poetry Text (Rückert):		
Am 19. Oktober 1816	146 words	73 words
Meaningful two-syllable words	92 words	46 words
Nonsense two-syllable words	68 words	34 words

An average speed is not given since Heller used his most practiced pupils. The question of the average speed in touch reading is still an open one.

Javal makes another casual reference to this (*5*, page 69, 71): "In touch reading," he says, "I am able to read 20 words per minute (in the French language); many congenitally blind people read 60 words; a small number read 100; a very few 120; while it can be assumed that the seeing, without omitting anything, read 500 words a minute." In the German language, Javal adds that touch reading is even slower on account of the compound words.

CHAPTER VII

Investigations on the Legibility of Braille Characters

As may be seen from the preceding sections, we need a great deal of enlightenment on the subject of braille writing as well as on the subject of touch reading, because this matter is of great importance to teachers of the blind to whom it is of vital interest. For this reason the author felt it necessary to conduct several experiments, chiefly in order to correct fallacies, to gain new insight, and to arrive at sound conclusions. Of the many questions which confront the educator of the blind in teaching reading, one of the most important is that regarding the recognizability of individual punctographic characters. The studies made by the author on this question and published in *Der Blindenfreund* led to completely new results (*1*). The main points of these publications are given here.

It has long been assumed that the braille characters composed of the fewest dots are easier to read than those composed of many. On the basis of this assumption, when braille was introduced into countries outside France, it was proposed to adopt a system, alleged to be more practical, in which the most frequently used sounds were distributed among the characters having the fewest dots. The Germans finally took over an unchanged braille alphabet.

However, the relationship between the numbers of dots and the legibility of the characters is shown in several sentences from Javal (*5*, page 184) in which he characterizes those composed of the fewest dots as the simplest, as well as the most readable. In reading, he says, he is easily confused by too many dots. In a proper name, for example, he does not differentiate easily between several letters each of which has more than four dots.

A cursory tactual examination of braille characters emphasizes the fact that the number of dots in each does not play that strikingly important rôle which had hitherto been ascribed to it, since it is obvious that a group of dots is easier to feel than one or two dots. To be sure, the grouping of dots into characteristic arrangements aids in the comprehension of their number and position. But there are letters with many dots which show such a characteristic form that they may be comprehended immediately through their characteristic shapes. An illustration of this appears in the comparison of ⠂ and ⠶. Although both have a similarity of form, the second letter has a greater extent than does the first and it is clear that the character ⠶ can be recognized quite as well as the letter ⠂ and

under some conditions even better. Therefore, the extension and characteristic form of braille letters is by no means of subordinate importance as compared with the number of dots. This has been pointed out already by Moldenhaver and Heller.

The number of dots and the shape of the characters, moreover, are considered in different ways according to the reading method. For example, in learning to read according to the present method of counting the dots and of comprehending the relative position of the dots, it is natural to give preference to the characters with the fewest dots. In regard to the study of braille and especially in regard to the writing of it, wherein the number of dots is of primary importance, Braille appears to have stressed that mathematical sequence which we notice in his system but to which there is by no means strict adherence. After braille reading has been learned, the dots are no longer considered, but attention is concerned with recognizing the symbols as a whole, as characteristic touch images. This fact has until now received almost no recognition in discussions of the legibility of braille.

It should be of interest, therefore, to investigate the legibility of braille characters and to try them out in a practical way. Research on reading should give us the facts about those characteristics which are important for increasing the ease of tactual reading. I have had to rely upon my own efforts in this, since the information from blind people whom I have consulted has been inexact and contradictory.

In these experiments I have adhered to the general proposition that those characters which are recognized most often during a fixed number of reading experiments may also prove to be the most easily interpreted by the sense of touch and the most easily read. This thesis does not need further discussion.

I again call attention to the fact that I confined myself first of all to the examination of single characters, since a combination of characters into words yields other tactual relationships, which must be investigated separately. For the experiment, only those braille characters could be considered which could be recognized by themselves. All these characters appear in the German alphabet with the exception of punctuation marks, the apostrophe, and the hyphen, but including the numeral sign. The numbers correspond to the basic characters and are, therefore, not taken into account. For these experiments thirty students from the Nieder-Österreichische Landes-Blindenanstalt were selected and these included pupils of all age levels and of different degrees of skill in touch reading. All of them were able to read and write braille skilfully. Almost all were totally blind, only a few of them having a slight degree of vision which was of no use to them in this experiment.

As the problem was presented, the chosen braille characters were to be recognized under fixed conditions. The number of readings, with pre-

liminary exercises, amounted to 12,000, a number which in my opinion warrants conclusions. Naturally, two or three times this number would yield greater validity.

Ten experiments were made on the touch process, each differing in some way from the others. With each experiment the thirty pupils read the thirty-eight chosen characters, and named the letters touched. Unknown letters were marked "O."

In determining the size of letter to be read in this experiment a small wooden reading tablet used to teach reading in the elementary classes was chosen.

These little tablets were made of wood and contained characters made of nail heads. The single dots were 6 mm. apart so that there was a letter width of 6 mm. and a length of some 6 to 12 mm. The dots themselves had a diameter of 2 mm. For Experiments 2 to 10 the characters were used in the usual size corresponding exactly to those in the Prague tablet. Each character appeared separately on a small sheet of paper measuring 8 cm. by 5 cm. The hard usage given to paper with embossed characters led me to make Experiments 7 to 10 using letters embossed on tin, which could not be pressed down.

The index finger of the right hand was decided upon as the reading finger. (The only exception was made for one pupil whose right index finger was missing so that he had to use his left finger.) The finger of the person reading was always guided by my hand, so that adequate and similar methods of touch perception were obtained.

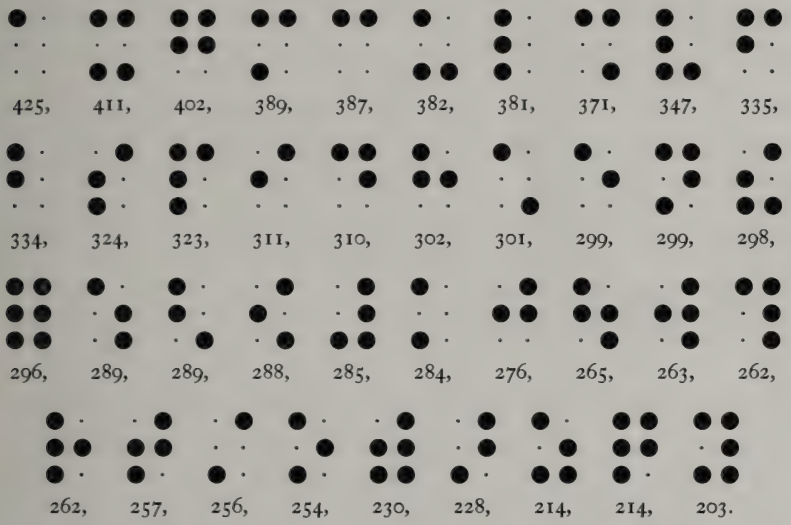
I chose to vary the directions of the tactual movements for each of three experiments: pressure alone, gliding movements from left to right, and downward movements, and in one experiment an upward movement. The circling (rubbing) movement, which always occurs with the perception of a single character, was not suitable on account of its complexity for a tactual experiment with so short a time duration. I therefore separated these movements into individual sections and arranged three experiments for these separate movements, with the exception of the upward movement which is of less importance in touch reading.

The duration of the pressure amounted to one second. The gliding over the characters was a slow and even movement in which the finger of the reader was guided as already has been said. In order that the subjects should become familiar with the purpose and the changing conditions, four to five preliminary experiments were given; the results of which naturally were not recorded.

Finally, in order to obtain sound results in touch reading, difficult conditions had to be introduced, since the finger itself would recognize most of the characters and the difference in tangibility would apply to a few letters only. Two methods were suitable for this. The relief of the dots could be pressed down and thus could be made more difficult to feel,

or the tactual sensitivity of the finger could be reduced in order to make perception more difficult. I chose the latter method by fastening rubber caps, such as doctors and bathers use, on the reading finger. It may be noted that the use of one cap had little effect, and that generally two or three caps had to be used in order to decrease perceptibly the strength of the tactual sensitivity.

The experiments that were reviewed by Ottokar Wanecek showed the following order of legibility in more than 25,000 readings, 600 readings for each character. Considering the frequent confusions of symmetrical characters, the following order of legibility was established (in later examinations the six-point characters were included):



Under otherwise similar conditions it was shown that reading with the bare finger gives better results than reading during which tactual sensitivity is dulled by the use of rubber caps. The simultaneous comprehension through the mere pressure of the finger is slower than recognition through touch movements. With pressure, larger characters which do not exceed the size of the touch spans on the finger-tips are perceived more easily than smaller characters. The firm tin characters are easier to feel than are those on paper.

The touch movements which appear to be the most important are those from left to right—even when rubber caps are used. With downward movements the characters are not so well recognized as with movements from left to right and the results with upward movements are relatively more limited. These increasing difficulties in comprehension are associated with the changing images resulting from the directions of the different

touch movements. Moreover, the downward, and still more, the upward movements, are unfamiliar as compared with the movement from right to left.

The observations on the involuntary touch twitchings and touch movements were as follows: when pressure was exerted by the finger, the attempt to try tactual movements either to the right or downward appeared clearly; with gliding from left to right, pressure or a downward movement was tried; with downward and upward movements, only a pressure pause was likely to appear; and finally, as soon as each restraint of movement disappeared, a circling (rubbing) movement in the direction was executed over the characters.

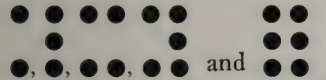
The most important and the most obvious result to be drawn from these experiments is the refutation of the theory that the characters consisting of a few points are the most readable. The relation of the number of dots to readability, therefore, is negligible.

We find first the characters of the simplest geometrical forms, whose superiority in regard to tangibility is unquestionable. In comparison with them most of the characters which are less simple geometrically are perceived less easily by touch.

The shape of the braille characters is, therefore, of so great importance that a study of their forms seems necessary.

CHAPTER VIII

Characteristics of Braille Symbols

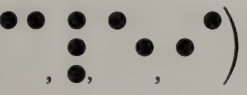
In general, the statement may be made that the braille system is far inferior to the print of the seeing—as may be seen by comparing the large roman type which today ranks next to braille in importance as a script for the blind. The few elemental forms of which braille is composed and the limited number of combinations which a six-point field permits allow only a very restricted range. Whereas in the roman type, which is our simplest line type, we have only a few similar characters and no "mirror characters," in the braille alphabet, with the exception of the characters  there are only those characters which, having the same shape, differ from one another according to change of position, among them being twenty-six which are symmetrically contrasting. The characteristic forms among these are as follows:

These eighteen forms, which are characteristic because of the number, extension, and position of the dots, compose only one-third of the fifty-one characters in the braille system. Therefore, braille must be regarded as being deficient in the number of its character forms. In richness of forms it is inferior to Johann W. Klein's *Stachelschrift* (pricked characters), and causes more errors in reading on account of its great number of similar characters. This fact was noted also by Heller. (*3,* page 95.)

The characteristic shape of braille symbols is a definite geometrical form; which is not the case with any other type. A summary, in which the changing positions appear in the parentheses, shows this clearly.

Dot form:

Combinations of dot forms:

Line forms: 

Combinations of dot and line forms:

Combinations of line forms:

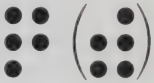
Corner forms:

Right corner:

Oblique corners:

Combinations of corner forms:

Surface forms:

Combinations of surface and line forms: 

Of importance for the form of the braille symbols is the fact already observed by Javal that they seem much more characteristic in their upper than in their lower halves. A closely related investigation yields the following results:

Dot 1	appears in	36	characters	}	Dots 1–4 in 67 characters
" 4	"	" 31	"		
" 2	"	" 31	"	}	" 2–5 " 62 "
" 5	"	" 31	"		
" 3	"	" 29	"	}	" 3–6 " 51 "
" 6	"	" 22	"		

The upper and middle four dots (1-4, 2-5) appear in this table in contrast to the lowest dots (3-6) in the ratio of 129:51.

The concept of every letter is conditioned by the number of dots, their distance from each other, their position, their extension and their geometrical form. All these characteristics are partly favorable and partly unfavorable to the legibility of the character. These influences are not recognized easily because of the complexity of their mutual activity, and their importance in touch reading cannot be evaluated easily. My experiments have yielded rather negative results; i.e., that the number of dots

are not of critical importance for tangibility, as had been previously supposed. My experimental analysis (*Blindenfreund,* 1913, pages 64-67) of the shapes, extensions, and positions of braille characters should be clear, but the influence of these separate factors on legibility has not yet been determined. Further experiments in this direction will bring much clarity on this point, and will make possible, without further objections, an arrangement of braille characters according to their legibility.

CHAPTER IX

An Attempt to Sketch Touch Movements

No experiment has yet been made to sketch the movements of the reading finger, although they have been much observed and described. When I thought about it, it seemed difficult, detailed, and impractical, since a mechanical arrangement for this must first be worked out. And finally it seemed questionable whether it was useful; that is, whether it would work with sufficient accuracy. It seemed to me most feasible to devise a fixed extension of the reading finger, ending in a point, which

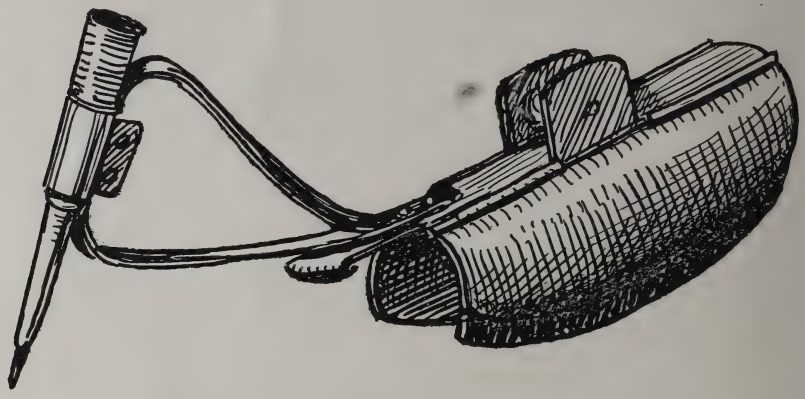


Illustration 3. Tastschreiber

would record the movements on paper. After several experiments I decided upon such an extension which I called *Tastschreiber* (touch writer). (Illustration 3.)

The *Tastschreiber* is a long clamp grasping the reading finger for two-thirds of its length. This clamp, when adjusted, leaves the first finger joint free on the under side, while the finger-nail touches the slightly bent end. At this place a curved wire loop is attached into which the forward part of the nail is inserted. On that part of the clamp which is above the finger-nail there is a projecting elastic loop about 3 cm. to 4 cm. in length, on the end of which a circular clip for a pencil is attached. The point of the pencil may thus move up and down but not to the left and right.

If the *Tastschreiber* is placed accurately on the reading finger, the end

of the pencil will trace the movements on a strip of paper placed underneath.

In order to obtain as much uniformity as possible, I used a slate on which a reading strip was inserted between two splints fitting closely to the end of a slip of paper. The reading strips were embossed on pieces of thin metal, and while the fingers were reading the braille, their touch movements appeared at the same time in pencil. The sketching of the touch movements followed, therefore, not on the characters themselves but, for the sake of clearness, on the paper above them. For the reading record I chose a strong paper, that could be wetted, so that the sketches

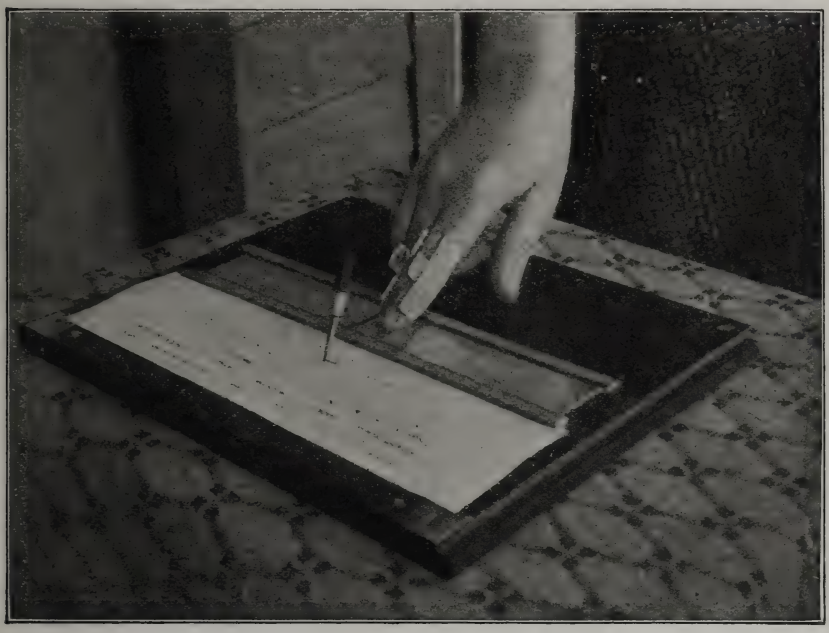


ILLUSTRATION 4. Use of the Tastschreiber

of the pencil inserted in the *Tastschreiber* would be sufficiently clear. (For similar experiments smoked paper might have produced smoother lines, but this would have made the experiment too detailed and tedious.)

Useful results were obtained from the first experiments with this apparatus, but certain inaccuracies, caused by the simplicity of the mechanical arrangements, should not be overlooked. The sketching of movements did not follow precisely the movement itself, but was somewhat wavering. The drawing appeared occasionally in too heavy lines so that the course could not be followed accurately. Also, the lines did not come above the characters to which they belonged, since the finger in reading

deviated from the vertical position to a greater or less degree. The reading finger could not be bent; therefore, because of this inflexibility, the whole hand was forced to make the touch movement usually attempted by the one finger. Despite these defects the usefulness of the *Tastschreiber* cannot be doubted. Perhaps improvements may be effected whereby the above-mentioned disadvantages will be remedied.

CHAPTER X

The Research and Its Results

Experiment 1. Touch Movements of One Reading Finger in Reading Single Characters

The first thing to be done was to determine the touch movements of one reading finger. For this experiment I selected all braille characters in full spelling. I omitted numbers and punctuation marks as repetitions of fundamental signs, since they are understood only in context. For the distance of individual characters from each other, I chose one which would let the finger fall upon a blank space of 1.5 cm. between each two characters. In order to maintain the customary width of the text, the thirty-nine characters selected had to be divided into four reading strips. An alphabetical sequence of these characters was prohibited. I used the following order, which I had obtained in experiments on legibility, since it seemed worth while to prove its accuracy in the new investigations. In addition to the braille characters the strips of paper contained the following information: name (of the reader); class; age; read braille since ——years; rates, as very good, good, average, poor, very poor reader; finger, i.e., right reading finger, left reading finger, right middle finger, left middle finger.

For the experiments fifty blind pupils were chosen who had already learned to read braille. Most of them were totally blind, yet there were some who had a small amount of vision and a few were able to read braille with the eyes even better than with the fingers. The subjects ranged in age from nine to eighteen years and were pupils of Grades III through V and of higher classes.

The subjects were taken individually, and were shown the empty tablet and the position of the hand; then the *Tastschreiber* was placed on the finger, while the purpose for putting it on was explained. After one of the metal strips (whose order of presentation naturally was varied) was inserted, and the paper strip was placed in position, the extended reading finger was guided to the beginning of the line (the other fingers remaining curved) ready to proceed. In the first experiment the right index finger was used as the reading finger. The individual characters were to be recognized and reported correctly.

Examples of the sketches of the touch movements obtained showed both an easier and a more difficult recognition of the same row of braille characters. While the good reader limited himself to the most necessary touch

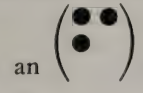
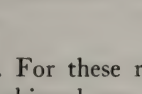
movements, the touch movements of unpracticed and poor readers were even more complicated.

With the first reading strip, a simpler touch line was given than with those which followed, yet the difference was less apparent with the practiced reader.

The first experiment indicated certain characteristic differences in the touch lines which were shown further as: a straight touch line running almost without a break; a quiet touch line with feeble convulsive movements (twitchings); a serrated touch line similar to the most simple writing movements; a meandering touch line; a touch line with several twitchings in the same place; a loop-like touch line; and a confused touch line.

What influenced this characteristic formation of the touch lines? Just as the orienting eye moving with lightning speed makes certain exploratory movements in reading, so does the hand of the blind have difficulty in finding its place. If an embossed sheet is given to the blind reader, he tries to perceive its extent by passing his hands over the text. In the upper left corner, where the beginning of the text is expected, the index fingers (generally the right) make zigzag movements of orientation and in this manner find the beginning of the first line. When the end of the line is reached, the finger-tips travel toward the left in the space between the lines, and thus find the beginning of the next line. Frequently the left forefinger takes care of this while the right is still reading the previous line. These widely distributed exploratory movements diminish proportionately as the reader becomes familiar with the arrangement of the text, the margins, the length of the lines, the space between them, and their number. In the first place, therefore, the tactual movements of the reading fingers are exploratory. They extend over the entire page, being especially marked at the beginning of the first line (on the reading strips they are seldom observed since the reading finger is placed in position) and they also run along the course of the lines, although here they are considerably reduced.

According to the law of conservation of energy which applies to tactual reading as well as to all bodily activities, all superfluous movements tend to disappear. The ideal touch line should, therefore, as soon as the beginning of the braille line has been determined, proceed as a straight line from left to right through the center of the letters; or it might be better to say that the touch span on the balls of the fingers must cover the span of letters on the lines. However, the finger-tip shows no such certainty in finding the direction and in maintaining it, and the reading finger for that reason is forced to deviate downward and upward from the straight line. These deviations from the ideal reading line result in the correction of the reading direction, especially at those places where the finger guesses at a character. If a good reader recognizes this character immediately, he will glide over it, but if this does not happen, further touch movements are

necessary. These movements also may have the purpose of ascertaining that some short character, for instance an  does not contain another dot  . For these reasons an unbroken straight-running reading line can not be achieved even by the best readers; rather, more or less frequent exploratory movements, whose form approaches that of a wavy line, are necessary for maintaining the reading direction.

Occasionally, continued and marked exploratory movements appear with very good readers, but these movements may be recognized as the result of nervousness. With such nervous readers the touching of the fingers on the characters produces involuntary twitchings. If the maintenance of the

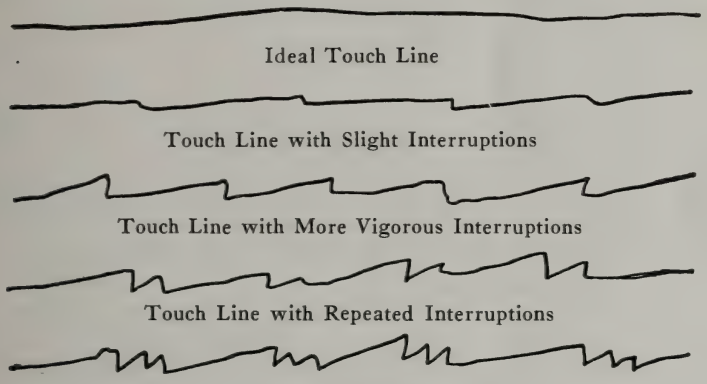

Ideal Touch Line
Touch Line with Slight Interruptions
Touch Line with More Vigorous Interruptions
Touch Line with Repeated Interruptions

ILLUSTRATION 5

reading direction is already difficult for them, the nervousness appears to produce a series of movements which the stable reader does not exhibit. These movements rarely occur downwards and upwards, but consist, as investigations show, of uneven glidings in different directions, chiefly forward and backward.

Touch movements are, however, also necessary to the recognition of characters (letters and words). A dot (and also an entire character) may be recognized by the pressure of the finger. But recognition is proportionately quicker and more certain as more spots on the skin are brought into contact with the character, and it is during touch movements that the best kind of contact with the characters occurs. For quick and accurate comprehension of letters, and especially of words, other movements (mostly upward and downward) are necessary in addition to the orienting ones. These movements are never present in the spaces between characters, but take place over the characters, once or many times according to the need.

The validity of this statement can also be shown in the fact that these touch movements are less frequent with good readers, but even with such readers they will appear immediately if they encounter illegible (flattened) text. Furthermore, these movements were also observed in the experiments in which the finger-tips were placed directly on the characters, so that they in no case could be considered as exploratory movements.

How important a rôle touch movements play in the assumed synthesis and analysis of letters and words remains to be seen. How perception and cognition take place is still an extremely obscure process which will be touched upon later.

Through the fusion of exploratory movements (apart from those at the beginning of the line) with the movements of recognition, the following scheme may be presented for the touch movements in the reading of individual characters (Illustration 5) which are placed at a distance of somewhat more than a finger's breadth from each other.

The shape of the interruptions is mostly serrated, but it also shows a meandering and loop-like character.

Experiment 2. Touch Movements of One Reading Finger in Reading Words and Sentences

Under conditions otherwise similar to those of the first experiment, two lines were read, this time with words and sentences respectively. This made it possible to observe which touch movements were carried out in the reading of groups of words and how the passage from one reading line to the next took place.

The fifth reading strip contained words (that is, groups of characters at their usual distance of 2 mm., and with the usual interval of 8 mm. between each two words) and it consisted of the names:

Otto August Hermann Konrad Ida
Georg Wilhelmine Vitus Kastor.

In addition to well-known proper names, two strange ones, unfamiliar to the reader, were chosen. The aim of this selection was to see if the latter could be read as easily as the others. The sixth reading strip showed two sentences:

Morgenstund hat Göld im Mund.
Xerxes war ein Perserkönig.

In the first, the well-known proverb had a mistake in the world "gold"; instead of the "o" the symmetrical character for "ö" was inserted purposely, in order to ascertain attention in reading. The meaning of the second sentence was less obvious to the reader with the strange words "Xerxes" and "Perser." The word "Perserkönig," with its eleven characters, also occupied the largest space.

At the beginning of the test the readers were told that this time they were to read two lines of words, and, therefore, not single characters as previously. Reading again was with the index finger.

It was observed during the examination that the reading of words with only one finger apparently was difficult for most readers, and was, therefore, very slow and required great attention. Many readers had to be asked to carry the reading finger back on the reading strip, as they wanted to bring it back in the air.

If one considers the course of the touch lines, regardless of the text, in those cases where the reading was relatively good, it can be seen that the good readers produced a slightly interrupted line, that the less able showed an increase of touch movements, and that this increase became even more noticeable with the very poor readers. The touch movements which deviated from the reading direction were closer together, because of the crowded position of the characters, than were these movements in the first experiment where the characters were placed farther apart. Sometimes there were only slight deviations; occasionally the touch lines showed wave-like movements; and frequently the lines were serrated. Larger movements were executed only at the beginning in recognizing difficult words, while the smaller movements served to distinguish the separate characters or to act as exploratory movements. The space between words was perceived clearly and traversed smoothly. At the beginning of the line distinct exploratory movements appeared. The passage from one line to another occurred in the space between the lines or on the one just read; seldom on the new. The regressive line in its smooth course was well differentiated from the reading line.

The recognizability of the words, aside from the reading difficulty of the individual characters, showed wide differences. For the most part the word images were comprehended and only with the words which were more difficult to read did the touch movements increase on account of the analysis of word images into letters.

After the cautious reading of the first word in the fifth reading strip the reader soon recognized that it consisted of Christian names, and this obviously facilitated his comprehension of the others. In the first line the words "Otto" and "Ida" created proportionately more difficulties despite the fewer characters. I account for this by crowding of the characters in the word "Otto" and the openness of the characters in the word "Ida." The word "Wilhelmine" was often, before it was wholly traversed, read as "Wilhelm," but as soon as the finger passed to the end of the word it was corrected to "Wilhelmine." The greatest uncertainty, relatively speaking, appeared in the second line in the names "Vitus" and "Kastor." The first was often immediately read correctly but was sometimes reread for certainty; with the last one, the syllable "Ka" was read easily while the syllable "stor" gave some difficulty.

In the sixth reading strip, as in the fifth, strange or unfamiliar words offered the readers the greatest difficulties, relatively, despite the fact that these words might consist of easily recognized characters. The significance of meaningful reading, therefore, stands out even more clearly. In the proverb, "Morgenstund hat Gold im Mund," after the comprehension of the first words the rest were traversed quickly. Of fifty readers the mistake in the word "göld" (made purposely) was overlooked by thirty-six and was noticed only by fourteen. The discovery of the mistake always required increased touch movements. Frequently, the words "Morgenstund" and "Mund" were read as "Morgenstunde" and "Munde." The principal difficulties of the sentence "Xerxes war ein Perserkönig," lay in the words "Xerxes" and "Perserkönig," in which the length of the last word apparently caused the most difficulty.

According to these investigations the touch reading of words and sentences exhibits great similarity to reading with the eyes, with the exception of the slowness of the processes. This takes place in a comprehensive manner through the apprehension of word forms. The greater the attention of the reader and the greater his vocabulary, the more significant is the rôle of assimilation. The passage from one line to the next leads to a pause which interrupts fluent reading.

Experiment 3

This experiment sought the answers to the following questions:

(*a*) Which Fingers Possess the Ability to Read?
(*b*) Which Finger Reads the Best?
(*c*) Which of the Index Fingers (or the Middle Fingers) has the Most Difficulty in Reading?
(*d*) Which Fingers are Generally Used in Reading?

Question (*a*). Which Fingers Possess the Ability to Read? The records of fifty readers were as follows: In forty-seven cases the index and middle fingers were characterized as qualifying in first place; in addition to these, in fourteen cases both ring fingers were used; and in fourteen other cases the ring finger and the little finger. Twenty-two readers explained that they could not read with the ring finger and the little finger. Two readers declared that they could read only with the index fingers, and another only with the index and right middle finger.

The index and middle fingers are the chief reading fingers, although with distinct gradations of ability. With the ring fingers the reading capacity is so decreased as to be useless; even less useful is that of the little fingers. The possibility of training these fingers for touch reading and of increasing their slight reading ability is out of the question, and there is no necessity for it. Therefore, I did not consider the ring finger and little finger in connection with the following questions.

Question (*b*). Which Finger Reads the Best? The following was shown:

Right index finger in 34 cases
Left index finger in 14 cases
Right middle finger in 2 cases

The last case concerned two readers who, at the age of fifteen and sixteen respectively, had learned touch reading without proper instruction. It is obvious that both index fingers are best for reading.

In accordance with preceding accounts the right index finger appears to be the better reading finger, and from my observations I am inclined to believe this is so. The announcement, however, that Paul Grasemann, a teacher of the blind in Hamburg, (with whom I collaborated and whom I have to thank for worthwhile suggestions) through his reading experiments found the left hand to be superior to the right hand in reading proficiency, caused me to examine my subjects according to his methods. I allowed them, just as he did, to read three pages of narrative material (full spelling or contractions); the first page with both hands, the second with the left hand, and the third page with the right hand alone. The reading times were recorded without regard to pauses or repetitions. The sixty-six readers could be divided into three groups: those who read equally well with both hands, those who read better with the left hand, and those who read better with the right. Following Grasemann, I included in the first group those who took the same period of time to read with the left and the right hand (where the difference was not more than 20 per cent); in the second group I included those who read more quickly with the left hand; and for the third group, those who read more quickly with the right hand.

Of the sixty-six readers

15 readers (23%) were equally good with both bands,
30 readers (45%) were better with the left hand,
21 readers (32%) were better with the right hand.

This confirmed Grasemann's experimental results and it was now necessary to find a reason for the different results obtained earlier on these same subjects. The comparison of the tables presented showed that only a few readers had confused left and right in their responses. On the contrary, a greater number claimed that they could read better with the right hand despite reading equally well with the right and left hands. Thus, in the first experiments the right-handed readers seemed to be in the same group with the two-handed readers, while they are separated in these experiments.

Question (*c*). Which of the Index or Middle Fingers has the Most Difficulty in Reading?

Left middle finger in 33 cases,
Right middle finger in 12 cases,
Left index finger in 4 cases,
Right index finger in 1 case.

Question (*d*). Which Fingers are Generally Used in Reading? According to these data reading is done:

With two fingers in 41 cases, that is,
with right index finger and left index finger in 37 cases,
with left index finger and left middle finger in 2 cases,
with right index finger and right middle finger in 1 case,
with right middle finger and left middle finger in 1 case.

With one finger in 6 cases, that is,
with right index finger in 5 cases,
with right middle finger in 1 case.

With three fingers in 3 cases, that is,
with right index finger, left index finger and right middle finger in 2 cases,
with right index finger, left index and left middle finger in 1 case.

Finally, as a control question, the following was asked: Which Finger is Most Effective for Reading? The answers corresponded to those given to Question (*b*).

The results of the foregoing can be summarized, therefore, as follows: the capacity for touch reading exists in all fingers. The reason why the index fingers, and occasionally the middle fingers, are used chiefly for reading lies in their more suitable position on the hand, in their greater flexibility, and in their greater skill acquired through practice.

The index fingers are regarded as the best reading fingers. Also, as a rule, none but the index fingers do the reading. Sometimes only one index finger is used. In exceptional cases a middle finger is also used in combination with one index finger. Still less frequently three fingers read together, the middle finger being used in addition to the index fingers.

In comparing the reading ability of the two hands it is found that with a quarter of the blind readers the right and left hands read equally well; with three-fourths of them, however, a difference may be noticed in that the left hand is somewhat superior to the right in reading skill.

Experiment 4. Reading Single Characters with Two Fingers

Except for one case in which both middle fingers were used, the two index fingers were always the reading fingers. In order to differentiate the touch movements of both reading fingers from one another, different col-

ored pencils were placed in the *Tastschreiber*, green for the right finger, red for the left. Reading was done on the third strip.

As a general observation on this experiment, it could be stated that the ability of both reading fingers varied with regard to the number and form of the touch movements. With good readers both fingers glided uniformly on the line so that a real difference in ability could scarcely be discerned, but in the majority of cases the line clearly showed the difference in performance between the two fingers. Movements of the right finger appeared clearly, but oftener the more extensive touch movements were carried out by the left reading finger. The movements of the one reading finger were followed closely by the second with more or less similar movements. Indeed, these parallel movements occurred involuntarily, since they appeared even where the second index finger was no longer running on the line. Occasionally one or the other finger was eliminated entirely. Finally, there were cases also in which both fingers seemed to be nearly equal in activity or to alternate in their work.

The predominant activity of one finger in touch reading might justify the assumption that in general only one finger reads and that the activity of the second finger serves only as a supplement or control. However, the relation which the touch movements bear to the separate parts of the reading process is not yet known. For this question two cases especially were taken into consideration, as they stand out from the foregoing study.

Case 1. Quieter reading lines of the right finger, more brisk movements of the left finger.

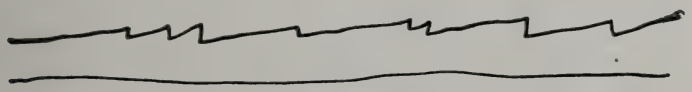


Illustration 6

Here a quick, superficial grasp of the words can be attributed to the right finger while the left comprehends them through the process of synthesis or analysis; hence the latter makes the final decision.

Case 2. Vigorous touch movements of the right finger, quiet touch lines of the left finger.

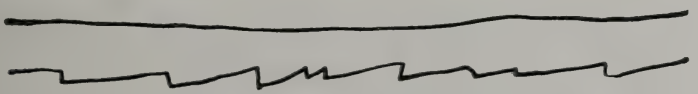


Illustration 7

A complete comprehension can be assumed here by the right finger, while the duty of the left is to serve as an apparently necessary control.

There might be considered, as additional cases, those instances in which the described activities of the two fingers alternate.

Experiment 5. Reading Words in a Sentence with Two Fingers (Both Index Fingers)

The following sentence embossed on two lines was chosen as the reading text:

Es war einmal ein Mann, Egbert
geheisen, aus dem Lande Bayern.

With a number of readers more or less quiet and uniform touch lines appeared which did not indicate a special dominance of one or the other finger. The search for the new reading line was effected usually by the left finger. With other readers a greater activity of either the right finger or the left was seen.

Reading difficulties were noticed chiefly with the words "Egbert" and "Bayern."

Experiment 6. Inventory of Pressure Strengths in Touch Reading

The movement of the reading finger over the braille characters is accompanied by a certain pressure in the touching of the characters. In the literature on this subject there is found no allusion to the strength or variability of this pressure. It may be seen from observation that touch reading with good readers proceeds with a relatively light and uniform finger pressure. Where reading difficulties occur, as in the case of beginners or with indistinct embossing, additional pressure strength may be assumed as being connected with the increased touch movements. The downward gliding of the reading finger over the braille characters which are difficult to recognize confirms this supposition.

In his investigation of pressure strength in touch reading, Dr. W. Kammel, Manager of the Pädagogisch-psychologische Laboratorium at the Nieder-Österreichische Landes-Lehrerakademie in Vienna, recommended the *writing balance* (scale) and assisted me most courteously in my experiments. Dr. Kammel described the experimental procedure in the following manner:

"The experimental analysis of pressure sensitivity in touch reading is effected through pressure and time measurements. In order to prove experimentally the very characteristic pressure ratio, we used the pneumatic apparatus which Ernst Meumann (*10,* Book III, page 538) describes. The blind pupils were allotted definite characters (letters, words, and short sentences) to read from thin metal plates, which were fastened to a movable wooden platform. This wooden platform was supported by simple wooden levers on two pneumatic cylinders,[1] by which the pressure was carried through a rubber tube to a small Marey drum. Its

[1] In order to make more precise measurements two cylinders were used. Meumann used only one.

recording pointer sketched (on a kymograph drum which was rotating fairly rapidly) the pressure changes in the volume of enclosed air which were produced by the reading of the braille. The determination of the time necessary for reading was sketched simultaneously on the kymograph drum with the help of an indicating magnet so that the moment was marked at which the reader touched the next character with the index finger of the right hand. Moreover, the time was recorded by means of the Jaquet chronoscope in fifths of a second, so that it was possible to determine the reading time to two-tenths of a second."

The experiments were carried on with fifteen pupils of the Nieder-Österreichische Landes-Blindenanstalt in Pürkersdorf who showed different grades of skill in reading braille. Reading was carried on with the right index finger only, without supporting the hand, in order to obtain a clear record of the strength of pressure. The reading was done on the first, third and fifth strips. From Figure II (*see* illustration at end of book), one can grasp the significance of the lines which can be seen on the strips. The entire upper line is the pressure curve, which is made by the recording lever of the small Marey drum; the horizontal dotted line is the normal or base line. As already illustrated, the marking of the moment when the reading finger touched a single letter or the first character in a word was made by means of a certain key, the record of which is to be found on the third line. In this way the reading text, as it appears on the reading strips, can be interpreted. The lower line shows the time record in two-tenths of a second and permits an exact determination of the reading time for the characters and words.

In the reading curves (Figure II, Nos. 1-3) for one piece of text consisting of single characters, we have before us three pressure lines wholly different from one another. The small rise of the first above the base line tells us that the pressure exerted in reading was only slight; the uniform course indicates that the reading finger passed over the lines with a constant pressure. This obtains for a good and even reader. Similar tracings are found with other good readers. The second pressure line shows an uneven course. With the touching of the first character it rises quite sharply and with each contact of the following characters a stronger pressure is released, although the line never rises so far as in the beginning. This line was produced by an average reader in one of the lower grades. The third pressure line is still more wavy. In particular, a stronger pressure is exerted in the first half, which rises sharply with each character, while in the second half the pressure variations diminish considerably. In the course of the pressure lines over the fifth character, the touch movements, combined with the difficulty of recognition, are credited as pressure variations. The reader, in this case a pupil of the lower grades, possessed average reading skill but he was a nervous boy so that a part of the variation in pressure was due to his nervousness. Other tracings of poor readers show the same characteristics which obtained in the third pressure line.

With the first subject the reading times for individual characters are al-

most the same (1 to 2 seconds), while greater differences (2 to 5 seconds) are noticeable with other readers. With poor readers the times vary even more widely. If the same text is reread by the same reader, the reading time may be shortened; the course of the pressure line, however, changes only a little.

The three touch lines described above may be considered as typical of good, average, and poor readers.

In the reading of words the same phenomena occur as appear in the reading of single characters (Figure II, Nos. 4-6). Again, with good readers there is a slight and uniform pressure; with average readers a stronger pressure and a rise in the pressure line for each new word; and finally, vigorous and increased pressure variations with poor readers. Also, the reading times which were shortened for words in general were divided much as they were with individual characters. The pressure variations are marked clearly in the passage over the lines. Pressure lines four and five are made by readers one and two, while line six, made by a good but nervous reader, exhibits the characteristics of the first and second lines.

A stronger pressure, which may be attributed to exploratory movements, is connected with the orientation at the beginning of the reading.

In the thirty tracings of pressure strengths which were obtained, one can recognize a characteristic course of the lines for each individual, so distinctively are these lines formed. In this regard there is a striking similarity to the handwriting of seeing people. Reading skill certainly is not the only important factor to be considered, as individual peculiarities also play a part. Nervous excitement stands out most strikingly in these pressure lines.

The results of this research may be summarized thus:

At the beginning of a line a stronger pressure of the reading finger is recorded by means of the pressure lines. These variations in pressure are closely connected with the exploratory movements of the reading finger.

Good readers generally show a straight, smooth pressure line running at a uniform height, while halting readers increase the pressure more or less. Reading difficulties, in conjunction with increased touch movements, lead to increased pressure, and thereby produce a wavy pressure line.

For each reader the pressure lines show an entirely individual character which results not only from the degree of reading skill but also from other individual peculiarities.

Experiment 7. Changes in Tactual Ability During Touch Reading

Prolonged touch reading naturally must be accompanied not only by mental fatigue but also by a reduction of tactual sensitivity in the fingertips. The opinion of teachers of the blind generally has been that the use of the finger for reading results in the rapid reduction of touch sensitivity

in the finger-tip, while on the contrary, the eyes of the reader of inkprint develop a greater endurance. Aside from the already specified conditions which make touch reading difficult or wholly impossible, blind readers also claim not to receive any clear impression of the characters after an extended reading period (four to five hours).

In reference to this Javal observes (*5*, page 7): "When I have read much, the dots feel like wool to the right index finger, but on the contrary, like points to the left. It is also true that rather widely divergent individual differences were observed in regard to fatigue in touch reading."

These were the facts with which I was acquainted when I approached the following experiment. For the study of the dulling of touch sensitivity in reading I chose the double-weighted aesthesiometer of Dr. Kammel. I could not, however, use it in his 5 mm. divisions for the finger-tips. Preliminary experiments confirmed the fact that 2, 3, 4, and 5 mm. are the most practical intervals for testing the finger-tips. These narrow intervals necessitated a modification of the pin heads, which were not round but flat. Furthermore, an increase of the needle's weight to 1.5 gr. was necessary in order to produce a correspondingly strong pressure on the somewhat thick skin on the end of the index fingers. The investigations on the changes in touch sensitivity were made on both index fingers in order to determine whether the reduction in touch sensitivity in both reading fingers takes place to the same or different degrees. The needles were placed in the first third of that line which was drawn from the center of the first finger joint to the tip of the finger, perpendicular to the median line. According to Dr. Kammel's method, in each of the intervals of 2, 3, 4, and 5 mm. a series of contacts were made, each series embracing three contacts and one surprise contact.

The reading time comprised six hours with a half-hour interruption after the third hour: that is, from nine to twelve o'clock in the morning; one-half hour pause; then from half-past twelve to half-past three in the afternoon. Material of ordinary difficulty, which was embossed in the usual size of dots (full or contracted braille according to choice), was read.

The measurements of fatigue of the forearm were combined with these investigations according to the results of Dr. Kammel, in order to secure a comparison between them.

Twenty of our pupils were chosen as subjects. Ten of these (five male and five female) ranging in age from sixteen to nineteen years were receiving vocational training. The other ten (five male and five female) ranged in age from ten to fifteen years. These students all read braille, but with varying degrees of skill. The grouping according to sex, age and occupation was made with a definite purpose. The trials were made

with groups of two or three readers. A larger number would have made too great a demand upon the experimenter for a scientific investigation.

The first results on three women readers showed the surprising fact that neither general fatigue nor reduction of touch sensitivity in the finger-tips was especially noticeable, despite the fact that the original four hours of reading time was extended to six hours. It was astonishing to find no fatigue in the results of one woman reader. Another reader had to stop from time to time during the sixth reading hour because she could no longer comprehend the material well. Nevertheless, the measurements showed no decrease in touch sensitivity. Since I used pointed stimulus needles for the first experiment on the finger-tips (weight 0.5 gr.) I concluded that perhaps during the reading a decrease of pressure sensitivity did take place, but that at the same time an increase of pain sensitivity occurred. Therefore, in other measurements of the finger-tips, I used dull but heavier needles (1.5 gr.).

The results showed that the ten students taking vocational training exhibited only a very slight decrease in touch sensitivity, but an increased number of wrong judgments. The fact is worthy of notice that the highest number of wrong judgments did not come at the end of the series but in

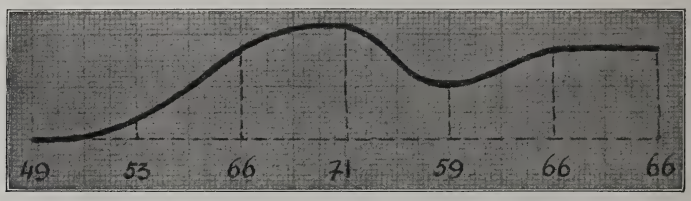


Illustration 8. Curve Showing the Diminution of Touch Sensitivity

the first half. The following summary of wrong judgments is given: 49, 53, 66, 71, 59, 66, 66. This produces an ascending curve until toward the end of the third reading hour, when it again ascends in the second half, although the first peak is not reached. (Illustration 8.)

It is obviously out of the question for the curve to rise again during further continuation of the reading. The two-peaked course of the curve agrees, also, with the statement of the readers that they experienced more tactual difficulty in the first reading hours than they did later.

If it is surprising to find in the case of the ten older readers that the decrease in touch sensitivity is only a slight one which progresses extremely slowly during a reading period of six hours (a very long reading time), then every expert will be even more astonished that there was no reduction in the sensitivity of touch with the ten younger readers. Three of the older readers did not make more than three wrong judgments; therefore, the decrease in their touch capacity was hardly observable. This fact

was shown even more clearly in the data for the younger group in which nine out of ten subjects persisted in making the same number of wrong judgments. A mistake in the above result may, therefore, be considered quite unlikely.

The results of the measurements which already have been considered are summarized thus: The dulling of tactual sensitivity in touch reading is very slight even after long reading periods. With older readers, who are not in constant practice, such a dulling is shown as a curved line with two peaks. With younger readers who practice reading daily, no dulling of the tactual sensitivity is observed after six hours of reading. It should be noted again that the measurements were made on blind individuals who already could read fluently and who had had years of practice. The results might be quite different, however, with those blind people who are just learning touch reading.

Concerning the extent to which general fatigue enters into touch reading, there is no confirmation of the earlier belief in a rapid increase of fatigue. In view of the limited number of measurements and the light, stimulating reading material, I do not want to make too sweeping generalizations, but I am inclined to believe that reading for the blind does not belong among the occupations which are most mentally fatiguing.

The distribution of wrong judgments (one point) in mm. distances is most interesting. They are arranged as follows:

	Distance				Number of Contacts of Each Interval
	2 mm.	3 mm.	4 mm.	5 mm.	
Vocational students	305	59	48	14	420
School pupils	351	..	..	..	420
Total	656	59	48	14	840

The greatest number of wrong judgments (656), both absolute and relative, occurs, therefore, at the distance of 2 mm.; and with the school pupils, all of the wrong judgments were found in this group. At the distance of 3 mm. wrong judgments (59) are greatly reduced, no longer occurring at all among the school pupils. This likewise obtains for the distance of 4 mm., while with 5 mm. the number of wrong judgments is very small (14 for the vocational pupils). These measurements show very clearly that the simultaneous spatial threshold on the tip of the index fingers lies between 2 and 3 mm. With 2 mm. a preponderant number of wrong judgments occurred. Only one reader made no errors. An interval of 2 mm. between the dots of punctographic characters would, therefore, seem to be too small, while on the other hand a distance of 3 mm. can be regarded as sufficient, even for unpracticed readers. In consideration of the fact that (according to reliable measurements) the successive spatial

thresholds are smaller than the simultaneous thresholds, and that the recognizability of braille characters is made easier through touch movements during reading, a normal distance of 2 to 3 mm. can be established as the best for the spaces between points.

Experiment 8. The Speed of Touch Reading

This experiment was undertaken to determine the speed of reading. For this purpose the following easy school text was given to fifty readers (from beginners in the third school year up to those in the continuation school), with just one minute for reading time:

"There are people who hold eating to be the most important task on earth. It is certainly not that. But, despite everything, it is an important task. Our state of health will be determined primarily by what we eat. For this reason it is possible for one to shape his development and his behavior according to his manners and habits of eating. It is not refined to hold the spoon too close to its bowl in eating nor to grasp it too tightly with the fist, to drink the remaining soup from the plate, nor to cut the bread on the table cloth. When you are through eating, place the implements not next to, but on the plate. Otherwise, it looks as if you are waiting for more. Finally, it is not refined to eat too slowly. It is unmannerly, in eating, to smack the lips. When one eats no one else should hear it."

The text was interpointed in full spelling, in the usual size of type employed in the printing shop of the kaiserliche königliche Blinden-Erziehungs-Institut in Vienna.

Before starting, the subjects were told to read as quickly as possible in their customary manner at a given signal, after their reading fingers had been placed on the beginning of the line, and at another signal to end the reading.

The words read, as well as the number of characters, were counted. The punctuation marks were put with the words where they belonged, and were added to the total as though they were characters.

The results in ascending order are as follows:

Reader:	1	2	3	4	5	6	7	8	9	10	11	12
Words:	19	29	31	33	36	37	40		41		42	44
Characters:	79	117	127	134	160	168	174		178		189	195

Reader:	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Words:			45				46		47	54		58		61	65
Characters:			201				205		210	232		250		263	284

Reader:	28	29	30	31	32	33	34	35	36	37	38	39
Words:	66	68	71	72	74	75		76		82	83	85
Characters:	289	293	304	309	318	320		324		342	349	361

Reader:	40	41	42	43	44	45	46	47	48	49	50
Words:	90	92	96		98	102	114		116	117	146
Characters:	383	390	406		418	429	485		490	494	621

Altogether 3,290 words with 14,131 characters were read.

The performances of the readers vary from 19 words with 79 characters to 146 words with 621 characters. The average for one minute of reading time is, in round numbers, 66 words or 283 characters.

The highest performance is, despite its uniqueness, undoubtedly worthy of notice. The performance of the best reader in Heller's experiment with seventy-nine words, was surpassed by fourteen readers. One must bear in mind, however, the easy text and the frequent repetition of short words. Nevertheless, there remained a certain superiority over the results obtained by Heller.

It is assumed that an average seeing reader reads 250 words in one minute and may read 150 words aloud, so that the speed of reading of blind and seeing readers, on the average, is such that the blind read three to four times more slowly than do the seeing.

Reading with both hands is the faster, while the use of one hand alone definitely lengthens the reading time. For my experiment I followed the procedure of my colleague, Grasemann of Hamburg, in that I permitted them to read a page of text first with both hands, then with the left hand alone, and finally with the right hand alone.

The average reading times for fifty-two readers were:

Reading with both hands	2 minutes 4 seconds
Reading with left hand	3 minutes 46 seconds
Reading with right hand	4 minutes 13 seconds

The fluency of reading appears in the following proportion:

Both Hands	1
Left Hand	1.82
Right Hand	2.04

This is a somewhat more unfavorable proportion than Grasemann obtained (1 : 1.64 : 1.71).

Reading with both hands is, therefore, the fastest. When only one hand is used in reading, the time is approximately doubled. It was said previously that on the average the left hand alone was able to read somewhat faster than the right hand alone.

CHAPTER XI

Proposals for Increasing the Speed of Touch Reading

The wide tactual field necessitated by the size of braille has resulted in a movement to decrease the size of the dots as much as possible in order to save space and time in reading. Several experiments of this kind had no results at first, but recently an attempt has been made to reduce braille to a height of 6 mm. and to a correspondingly reduced width. This reduced braille is considered very legible by many blind people, while others claim it is more difficult to read than braille of the usual size. With too great a reduction in size, the saving in time that would result from the reduced tactual field would be lost again through decreased legibility. Moreover, experiments should be made to determine the limits within which such a reduction in size can be of value in regard to speed of reading. It has already been pointed out that a reduction in the usual size of braille is possible.

The pause caused by the gliding of the finger from one line to another has led to the proposal that in order to shorten the tactual field the text should read from left to right in the odd lines, and from right to left in the even lines. Then the finger would pass down at the end of the odd line immediately to the beginning of the even line beneath, on which letters and words appear in the reverse order. The word "Vaterhaus" could therefore appear in the following two ways:

Odd line

Reading direction →

Even line

← Reading direction

Thus, not only a mere reversal of the word image occurs, but also a more extensive change appears which is shown in the above example. Whatever time is saved in the hunting of lines is again lost immediately through the change of the image and the consequent difficulty in reading. This proposal can not be realized in practice even though it is used already in Moon type (a line type in relief).

An actual saving of time and an increase of speed lies in the use of contracted braille. This consists of a number of syllable and word abbreviations and, therefore, effects a reduction in the number of char-

acters as compared with full spelling. With a corresponding degree of practice the reading of contracted braille is without question faster than the reading of full spelling, even though the objection has been raised that with an insufficient knowledge of contractions the slowness of deciphering the characters equals or even exceeds the saving of time. With contractions the word images are highly diversified and, therefore, they have more characteristic forms which aid tangibility.

Contractions form a transition from the alphabetical system of full spelling to a phonographic system. Javal, who was intensely interested in devising a means of accelerating touch reading and who considered the usual contractions impracticable, claims that in the choice of stenographic characters the greatest attention should be paid to the needs of phonetic writing. (*5,* page 138.) With reference to this he suggests going back to the old Barbier system, while retaining the six-point field, and then making a gradual transition from phonographic writing to the rapid stenographic. Without doubt such a method of writing, if it could be carried out, would bring a greater increase in the speed of reading. Because of the widespread adoption of the existing contractions, however, the acceptance of a new system is hardly to be expected.

Finally, the justifiable objection is raised against the braille system that the most used letters are not identical with the most readable; frequency and legibility, therefore, do not go hand in hand. By observing the principle of recurrence, legibility certainly would be increased. Such experiments have already been undertaken (the New York Point System among others). These, however, were so superficial that they had no success. A basic change of the braille system must consider the mass of embossed literature which would be worthless if a new system were accepted. Moreover, before a change in system can be considered, the process of touch reading must be understood thoroughly in order to create a basis for improvement which hitherto has been lacking.

CHAPTER XII

Touch Reading and the Newer Investigations on the Sensations of Touch and on Eye Reading

The reading process is not simple, but extremely complicated. Meumann (*10,* page 464) called reading with the eyes a psychical world in miniature, since it calls into use: the perception of characters; the performance of activities, by which we grasp the meaning of the characters; the memory, by means of which we comprehend what has gone before while we are reading the next; the intelligence, by means of which we grasp the interrelation of what is read; the will, for which reading is a spontaneous act; and the feelings, through which the reading content acquires more or less interest for us. Added to this are the motor processes of silent or oral speech. It is clear that the process of touch reading is still more detailed than this, while the intellectual assimilation of the sensations obtained thereby are similar to those connected with eye reading.

If the results of the new experiments on eye reading cannot be used without change on touch reading, they nevertheless deserve great attention because of the many similarities between visual and tactual reading. Also, methods of research which are used in visual reading may be adapted to investigations of tactual reading. For example, it is obvious that apparatus may be produced for the recording of touch movements which can work much more exactly and correctly than my simple *Tastschreiber.* Especially, attention is called to those apparatus which already have been tested out for registering mechanically and sketching photographically the movements of the eye in reading. The use of such apparatus certainly would furnish new results and would make possible studies for which the *Tastschreiber* does not suffice.

As we have seen, our information concerning the psycho physiological aspects of touch reading are very meager and inaccurate. Heller, the only one who has been particularly interested in this, distinguished in his explanations two kinds of touch, synthetic and analytic. For the reading of braille he accepts as an established fact (*3,* page 93) that neither analytic nor synthetic touch can lay claim to an independent position, but that both contribute to the development of a satisfactorily broad concept.

"The development of touch reading evidently is influenced, on the one hand, by the necessity of obtaining an adequate idea of the embossed characters; and on the other, by the law of the conservation of energy. With regard to the latter, blind people, after long practice, are satisfied with receiving directly only one of those factors which appears necessary for the development of the correct spatial

concept, while the other factors are completed through reproduction. With the reading of braille the capacity for reproduction is interchangeable between the two factors. It is possible not only for the successive impressions to call forth simultaneous impressions, but also for the simultaneous to call forth the successive. In the choice of the two kinds of touch, the law of conservation of energy guides the blind reader; in this way he decides in favor of synthetic touch in order to gain an immediate impression."

This explanation of Heller's seems imperfect in so far as the investigations of M. v. Frey on the sensory capacity of the human skin and on the fusion of skin sensations have supplied new points of view in regard to touch reading. Frey understands this fusion to be a psycho physical process, to which the excitations of the nervous system are subjected, these excitations flowing into one another and forming a new, more or less unified impression. (*2*, page 217.) In particular, this process is evident in the investigation of the spatial threshold of the skin, which forms one of the bases of our spatial ideas. (*2*, page 220.) The special form in which the appearance of fusion is manifested in the sphere of the pressure sense, consists in this; that two or more simultaneously placed excitations lose their spatial independence and fuse into a total impression of unitary localization. (*2*, page 223.)

If two points on the skin are stimulated simultaneously, at not too small a distance from one another, the sensations belonging to each retain a special characteristic or quality. While they seem clear cut, i.e., well separated from the remaining content of consciousness, nevertheless, in a simultaneous excitation they become indistinct, intermingling or dull. They are then difficult to separate from each other and seem to be united as by a bridge. Frey characterizes this process as the mutual blunting of adjacent excitations. This is the first degree of fusion.

As the two stimulus spots on the skin approach each other, the separation of the excitations will become more difficult and they will fuse finally into a new, completely unitary impression. This is the second degree of fusion. The more dissimilar the force of both excitations the more easily does fusion take place. The spatial threshold of Weber, or the simultaneous threshold, as Frey calls it, is then reached. In this way, in the case of excitations of equal strength, each of the two impressions loses its own place value; in the case of excitations of unequal strength, the weaker impression is the loser and a new, commonly shared place value appears. This simplification appears only with simultaneous stimulations; when they are made at different times each excitation maintains its apparent position. If both positions on the skin are stimulated successively, and then simultaneously, the impression is given that the two stimuli have moved toward each other. (*2*, page 224.)

The fact that two points which are only a short distance apart are difficult to separate from one another and that they seem to be bound together as by a bridge, seems to prove the assumption that in touch

reading the dots of one character cannot be felt separately but that a unit picture of the characters is perceived and that, therefore, the shape of the characters is of decided importance for comprehension. A fusion of the dots by lines, as proposed by Kunz and Javal for increasing the tangibility of braille, thus seems superfluous.

The fusion of two dots occurring within the limits of the spatial threshold results, according to Frey, only in a simultaneous stimulation, while with stimulations not simultaneous each of the two excitations maintains its apparent position. This seems to explain sufficiently well the necessity of touch movements in tactual reading. The movements occur in order to bring about a non-simultaneous stimulation in order to make comprehension possible in difficult cases and, in general, to make touch reading easier. In this connection it might be said that since a simultaneous contact with the dots never occurs in touch reading, the distance of the dots from each other might be reduced below the spatial threshold. Thus, something might be said in favor of a reduction of the punctographic type. The touch movements occur, therefore, more in accordance with the above-mentioned purpose than with the inner sensations of movements, as these terms are employed generally by Heller and Hocheisen.

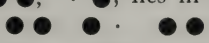
The investigations of Ranschburg also indicate that in the transference of sensation from the outer world to consciousness, not merely intensity, number, affective tone, etc.—the stimuli running concurrently in consciousness—but also the quality of these sensations, their reciprocal relations, their uniformity, similarity and difference from each other, are all of decided importance. (*11,* page 161.) Also, concerning reproduced ideas as secondary stimuli effects, the conditions mentioned above may be considered valid. Similar ideas seek to fuse with each other but are interrupted each time in their independent development, their observability and their reproducibility. Heterogeneous ideas disturb each other only in so far as each claims for itself a certain measure of attention, but not in the independence of their qualitative character. (*11,* pages 163 and 164.) Similar elements seek to join each other; the dissimilar elements stand out from each other and separate themselves from the similar ones in accordance with their degree of difference. (*11,* page 165.)

This fundamental psychological law proves again that the homogeneous stimulus effects of the dots in touch reading unite into a whole and that they emphasize the value of characteristic letter and word forms. Further, this law seems to explain the differences in the perception of similar characters. The order of legibility stands thus (page 21): the character fourth, but the character only in the

tenth place. Likewise, is in the sixth place, in the sixteenth place,

in the eighth place; but in the fifteenth place. The easier per-

ception of the characters , , , lies in their heterogeneity; the



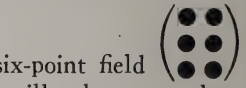
great difficulty in the characters , , , lies in the more homogeneous arrangement of the dots in their relation to each other. Therefore, open characters (with dots wider apart) possess a better legibility than similar ones with the dots closer together. Only those closed characters

which show quite simple geometrical forms have an advantage perceptually.

CHAPTER XIII

Summary of Experimental Results

The following conclusions from investigations on braille and touch reading, presented in logical order, supplement the preceding assumptions.

Braille. The particular suitability of braille for touch reading is established. The arrangement of the dots in an upright six-point field  appears to be the most practical. The legibility of braille characters does not coincide with the number of dots they possess but it is the characteristic shape of the characters which is most important for their recognizability.

Size of Braille. The usual size of the characters (7 mm. high by 4.5 mm. wide) may be considered satisfactory as an upper but not as a lower limit. The most useful spacing of the dots from one another lies between 2 and 3 mm., but this is still to be determined through intensive research. A reduction of braille type below the present measurements seems possible.

Necessary Space Required by Braille. In comparison with inkprint this is a very important matter. Under favorable conditions braille books surpass inkprint ones of equal content thirty fold in the amount of space occupied, while under unfavorable conditions they surpass them fifty fold and more. This fact probably will not be much modified in the future.

The Organ for Reading. The size of the touch surface on the end of the finger varies and does not always exceed the height of the braille characters. Because of their preferred positions, the index and middle fingers of both hands are of importance, although there is the possibility of touch reading for all of the fingers. The position of the hand, arm, and body assumes special significance in touch reading; therefore, special attention must be paid to it.

The Process of Touch Reading. The mechanical activity consists in different kinds of touch movements of the fingers and hand. The index fingers of both hands seem superior to all others as reading fingers. In reading with both hands the use of the middle finger is unusual. Between these touch organs a division of labor takes place which varies according to circumstances. Until the present time, no clear idea has been obtained concerning inner comprehension in touch reading.

Touch Movements. Touch movements of the reading fingers are partly exploratory movements and partly necessary movements for recognition.

Their frequency parallels their recognizability. For good, smooth readers their course forms a straight-running line; with less capable readers they assume a serrated or twisted character; and with poor readers the movements increase to the point of confusion. If two fingers read simultaneously more or less similar movements result, yet the greater mobility of that finger which does most of the work stands out clearly. Accompanying the crowded movements of the one finger the other follows with more or less similar movements.

The Strength of Pressure in Touch Reading. A corresponding pressure of the fingers is connected with touch movements. With good readers this is slight and uniform. Reading difficulties connected with increased touch movements lead to heavier pressure. With poor readers finger pressure is stronger and more unsteady. At the beginning of a line the pressure is increased because of exploratory movements.

Changes in Touch Capacity during Reading. The decrease of touch sensitivity in touch reading is very slight even after hours of reading; the same thing is true with general fatigue, so that reading for the blind cannot be considered as especially fatiguing.

Speed of Reading Braille. On the average, the blind read three to four times more slowly than do the seeing. The reading of words and sentences occurs in a comprehensive manner through the apprehension of word forms. Where reading difficulties arise there is an analysis of the word forms. Reading with both hands is the fastest. Reading with one hand alone approximately doubles the reading time. The left hand reads alone somewhat better than does the right.

BIBLIOGRAPHY

1. Bürklen, Karl. Untersuchungen über die Lesbarkeit der Brailleschen Punktschriftzeichen. *Blindenfreund* (Düren, Hamel) *33*, 2/3. 1913.
2. Frey, M. v. Neuere Untersuchungen über die Sinnesleistungen der menschlichen Haut. *Fortschritte der Psychologie* (her.: Marbe; Leipzig, R. G. Teubner) *2* (4). 1914.
3. Heller, Theodor. Studien zur Blindenpsychologie. Leipzig, W. Engelmann. 1904.
4. Hocheisen, Paul. Der Muskelsinn Blinder. Berlin, G. Schade.
5. Javal, Émile. Der Blinde und seine Welt. Hamburg-Leipzig, Leopold Voss. 1904.
6. Kammel, W. Eine neue Methode zur Bestimmung der Ermüdbarkeit mit Demonstration eines neuen Gewichtsdoppelästhesiometers. *Jahrbuch des Vereins für christliche Erziehungswissenschaft* (München, J. Kösel) *7*. 1914.
7. Kunz, Martin. Abhandlungen in: *Geschichte der Blindenanstalt zu Ilzach-Mühlhausen i. E.* (Leipzig, W. Engelmann) 1911.
8. Mell, Alexander. Der Blindenunterricht. Wien, A. Pichlers Witwe u. Sohn. 1910.
9. Mell, Alexander. Abhandlung in *Enzyklopädisches Handbuch des Blindenwesens* (Wien, A. Pichlers Witwe u. Sohn) 1900.
10. Meumann, Ernst. Vorlesungen zur Einführung in die experimentelle Pädagogik. Leipzig, W. Engelmann. 1914.
11. Ranschburg, P. Über die Wechselwirkung gleichzeitiger Reize im Nervensystem und in der Seele. *Zeitschrift für Psychologie* (her.: Schumann; Leipzig, Johann Ambrosius Barth) *66*. 1913.
12. Schulze, R. Aus der Werkstatt der experimentellen Psychologie und Pädagogik. Leipzig, R. Voigtländer. *3*. Aufl. 1913.
13. Wanecek, Ottokar. Untersuchungen über die Lesbarkeit der Brailleschen Punktschriftzeichen. *Blindenfreund, 34* (7). 1915.
14. Wundt, Wilhelm Max. Grundzüge der physiologischen Psychologie. Leipzig, W. Engelmann. *6*. Aufl. 1910.
15. Zech, Friedrich. Erziehung und Unterricht der Blinden. Danzig, A. W. Kafemann. 1913.
16. Das Raumerfordernis der Punktschrift. *Zeitschrift für das österreichische Blindenwesen.* (Wien) *3* und *4*. 1916/1917.

Part II

MINOR ARTICLES ON THE PSYCHOLOGY OF BLINDNESS

ARTICLE I

An Investigation on the Reading of the Blind

By Paul Grasemann[1]

Hamburg, Germany

The reading of the blind is acknowledged to be one of the most interesting problems, and it seems quite natural, therefore, that many teachers of the blind have turned their attention to this particular subject. Thus far, studies upon this question have been dependent almost exclusively upon mere observations or statements of individuals, and for this reason complete validity is not claimed for them. Only recently has the attempt been made to investigate this subject by experimental methods. I have tried to contribute a study which will explain the reading process of the blind by means of experimental methods and have been especially interested in the question of the extent to which both hands share in the reading of braille. I need not quote here the various opinions on this subject, but I refer to the work of Director Bürklen in this volume.

In early times the right index finger was considered the proper reading finger for the blind, while the function of the left index finger was to find the following line in order to avoid an interruption in reading. Later, it was believed that the left index finger played an important rôle. While the right index finger was intended to take over the so-called "service of recognition," the left took over the "service of control," i.e., it supplemented or corrected the word images comprehended by the right hand. Heller believed that the right hand comprehended only superficial synthetic collective images, while the left hand served rather for slow, analytic touch.

For a more precise investigation I chose a selection from an ordinary braille book which contained a description of the physical characteristics and habits of a wolf, and from this I again selected three pages which presented the reader with about equal degrees of difficulty. Precautions were taken to exclude geographical names or technical expressions, as these naturally would offer greater reading difficulties. The first page was read with both hands simultaneously, the second with the left, and the third with the right hand alone. The reading time was recorded for every trial; also the number of errors occurring and the number of corrections. Finally

[1] Translator's note. Herr Paul Grasemann is now Director, *Provinzial-Blindernanstalt,* Soest, Westphalia, Germany.

the number of corrected and repeated words was determined, since these afford a unit of measure for accuracy and lack of accuracy in reading.

The following various interesting questions were answered:

I. Which method of reading is most satisfactory; that with both hands, that with the left, or that with the right alone?

The average reading time was 153 seconds with both hands, 87 seconds more with the left hand alone (an increase of about 57 per cent), and 108 seconds more (an increase of about 70 per cent) with the right hand alone.

Thus it was shown that reading with both hands is greatly superior to one-handed reading. Obviously, to request some of the subjects to read with only one hand might have been unusual and unnatural for them. It undoubtedly would have been possible to decrease the reading time for one-handed readers considerably with special practice. This, however, will be discussed later.

II. Which hand plays the greater part in reading?

Earlier observers have confirmed the fact that many readers make use of both hands equally, others depend more upon the left hand, while still others depend more upon the right. As already pointed out, the right hand was believed to be the most important. In order to determine how much each hand shares in the reading process I assumed that those readers who showed about the same reading rate in one-handed reading would use both hands at about the same comparative rate in two-handed reading. Therefore, I assumed a similar participation of the two index fingers when the difference in reading time between them was less than 20 per cent, and I characterized a reader of this type as two-handed. If the time of the right hand was greater than that of the left by more than 20 per cent, I considered it left-handed reading; whereas, if the time of the left hand exceeded that of the right by more than 20 per cent I called that right-handed reading.

On this basis I found that the first 7 subjects were two-handed readers, the next 15 left-handed, and the last 9 right-handed readers. We had, therefore, 22.5 per cent two-handed, 48 per cent left-handed, and 29.5 per cent right-handed readers.

Therefore, this throws new light upon the rôle played by each hand in the reading of the blind. Since approximately half of the subjects depend more on the left hand than on the right, there is no foundation for the previously accepted supposition that the right index finger is the real reading finger. This fact is also in accordance with Heller's psychological explanation, viz.: The right index finger assumes the function of orientation with respect to the word image, while the left makes the analysis; therefore, the principal task in reading is assigned to the left finger. There is also a sound technical reason for the predominant activity of the left finger. When the blind copy from a book (which is very frequently required of

children) they use the right hand to hold the writing stylus, while the left hand alone reads the written text; hence the left index finger has greater practice.

Therefore, we can affirm that the right index finger can be considered in no way as the proper reading finger; but rather the left finger.

III. Which type of reader has the advantage?

We have classified above, two-handed, left-handed, and right-handed readers. The designation left- and right-handed, however, was not meant to imply that these individuals read only with one hand, since all blind generally read with both hands at the same time. Of the 31 subjects only one always read with the right hand alone. If we wish to discover which readers are at an advantage, then we must take the reading rates of two-handed, left-handed, and right-handed readers during natural reading. The average reading rates were as follows:

	Seconds	Increase
Two-handed:	135	0%
Left-handed:	154	14%
Right-handed:	163	21%

Also, the inaccuracy and uncertainty in reading was greater in the case of right-handed and left-handed readers. This was shown clearly in the increased number of mistakes and repetitions. That right-handed readers are more accurate and certain than left-handed readers probably is due to the fact that in their case the real reading finger comprehends the letters first and with greater accuracy, while the left-handed readers feel over the next words casually and rely upon the correction of the left hand.

The reason why two-handed readers are at an advantage is that they can accomplish more easily the passage from one line to another. They read the first part of a line with both hands, but in the last third (with many readers, even in the last half of the line) the right hand reads on alone, while the left hand finds the beginning of the next line and comprehends the contents in advance.

Javal made this same observation with a skilled reader, and expresses it as follows: "When, for instance, his right index finger came to the end of the line, the left already had probably reached the middle of the following line, so that the left finger was always ahead of the right in reading, while the right followed the spoken word."[1]

IV. Of what value to the blind is two-handed reading?

Although the left-handed readers rely upon the left hand and the right-handed rely upon the right, the use of the second hand is not without value in the process of reading. It is possible to confirm this statistically by comparing the reading times of groups of one-handed readers with those of two-handed readers. The results are as follows:

[1] Javal, *Der Blinde und seine Welt.* 1904. Page 71.

Two-handed Readers:

	Reading time	
One hand	211 seconds	
Both hands	135 "	
Shortening of reading time		76 seconds (36%)

Left-handed Readers:

	Reading time	
Left hand	188 seconds	
Both hands	154 "	
Shortening of reading time		34 seconds (18%)

Right-handed Readers:

	Reading time	
Right hand	215 seconds	
Both hands	163 "	
Shortening of reading time		52 seconds (24%)

It is obvious that the greatest shortening of the reading time occurs in the case of two-handed readers when the second finger is added. This can be explained by the fact that both hands share equally in the reading. Therefore, what is missed by one finger of a one-handed reader places him at a disadvantage which is compensated for by the addition of the second finger.

With the right-handed reader the significance of the two fingers lies, probably, in the quicker finding of the next line; with the left-handed reader, however, in the easier holding of the line, and in the perception of word images.

Still more striking is the significance of the second finger with regard to reading accuracy, since we find with its use, on the average, a reduction of 25 per cent in reading errors and a decrease of approximately 35 per cent in repetitions.

In order to check the results sketched in the above table, I undertook still another series of experiments. They are different from the first in that I chose not a stereotyped, but a hand-copied text. Therefore, I had an added advantage in that I could avoid every reading difficulty and could limit each reading passage accurately to 100 words. Furthermore, this investigation included contractions—a kind of stenography consisting almost entirely of syllables and word abbreviations. The result of this experiment was about the same as the preceding; among 37 subjects we found:

18 left-handed, or 49%
12 right-handed, or 32%
7 two-handed, or 19%

Again the fastest readers were two-handed, then came the left-handed and finally the right-handed.

Director Bürklen of Vienna found similar results after trying out this experiment. Of his 58 subjects, 23 per cent were two-handed readers, 45

per cent left-handed, and 32 per cent right-handed readers. The small variation in the distribution is explained easily both by the type of pupil material, and by the effect of the instruction.

The following inferences may be drawn from the results obtained:

1. That when teaching the blind to read, it should be kept in mind that the real reading finger is the left index finger. Therefore, the teacher, especially at the beginning, should place the left index finger on the type. If the pupil objects, however, he should be allowed to use the right index finger in reading. It should also be observed whether or not there are scars or other peculiar formations of the skin which will make a finger unsuited for reading. In this case the teacher must induce the pupil to use another one, perhaps the middle finger, as the reading finger. It is necessary, also, for the teacher of the blind to have an accurate knowledge of his pupils' capacity for reading.

2. Since the two-handed reader excels by far the one-handed reader, it is possible to differentiate two grades of reading, the one-handed and the two-handed. I believe myself doubly justified in making this differentiation, since the two-handed subjects in my series of experiments always were those who had the most reading practice. Therefore, the efforts of the teacher of the blind should be directed towards bringing the blind reader to the step of two-handed reading. For this, it is not enough to coax the pupil repeatedly to use two hands, for the teacher does not always have control over the simultaneous participation of the two hands; rather, one must educate them systematically to use the left as well as the right finger, through practice in reading with only one finger at a time. This practice will then be advantageous for two-handed reading, and will result in an increase of speed.

3. It is evident that the reading of the blind represents a much more complicated psychological process than that of the seeing. While these (the seeing) with one glance are able to look over a whole row of words, the blind perceive in one instant only that word which is directly under their fingers. In order to read fluently they must make a point of reading as many words as possible before they speak them and, therefore, a whole row of words must stand in their consciousness. This great demand makes it clear that a comparatively higher grade of intelligence is needed for fast reading by the blind. Furthermore, only through constant practice can reading skill be acquired and maintained, for the blind decrease easily in reading efficiency with insufficient practice.

Finally, I hope that the experiment outlined above will be checked in many places so that more light can be shed on the interesting reading process of the blind.

ARTICLE II

An Introspective Study on the Psychology of the Blind[1]

By Ludwig Cohn

Breslau, Germany

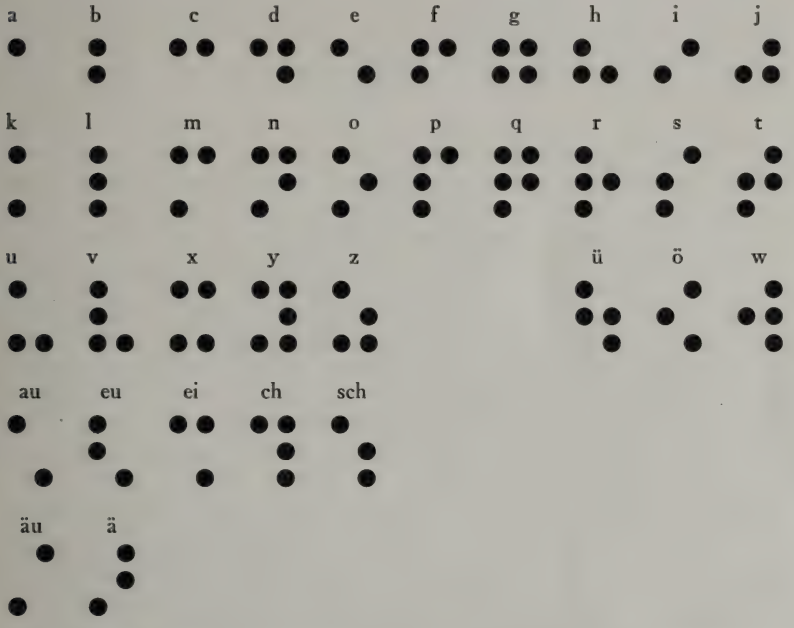
If the present paper must appear under the protection of a *captatio benevolentiae* it is because I must speak so much about myself. Still, this is unavoidable due to the intrinsic character of the subject, as it deals for the most part with self-observations and with active experiments on or with myself.

At the age of six years I was blinded to an extent which made attendance at an ordinary school impossible and, therefore, I was educated in a special institution for the blind. My vision grew steadily worse until by my sixteenth year I was totally blind. I mention this fact in order to refer to it later on, since it is of utmost importance in dealing with the psychology of blindness to know whether loss of vision occurred immediately after birth or later. In my opinion the whole psychology of blindness hinges upon this point, viz.: to what extent is it possible for a blind person to compensate for his handicap and preserve his mental equilibrium? This is shown in the case of the war-blinded whose mental balance has been shaken through loss of sight.

First of all, the tactual sense through special training and practice acquires the ability of changing the optical sensations to touch sensations, and of adjusting the imagery accordingly. This ability is just as much a question of practice as is that of a person who gains his sight when he learns to use his eyes and to recognize as an optical image that which heretofore he had recognized as a tactual image. Consequently, the a priori acceptance of the superior tactual sense of the blind is erroneous, in so far as it is regarded as one of their special characteristics. I know seeing people who have learned to read embossed print successfully with the fingers.

[1] The information contained in this article is essentially the same as that embodied in a lecture which Dr. Cohn delivered in the philosophical-psychological section of Schlesischen Gesellschaft für vaterländische Kultur. Dr. Cohn is not a psychologist, but rather a sociologist and historian; therefore, his terminology does not always coincide with our professional usage. Nevertheless, the author's contribution in describing his introspections has psychological interest, since the psychology of blindness (which until now has been dealt with almost exclusively by the seeing) is in urgent need of comprehensive, introspective material, contributed if possible, by people who possess training and who can make scientific criticism.

This print was invented by Louis Braille in 1829 and was called braille after him. It is based on the principle that the touching finger within a space of not quite one square centimeter, recognizes pictures out of a dot complex of this form: These pictures consist of from one to five dots.



It has been shown that to perceive images within this six-point complex only one single touch movement is needed, and reading, therefore, is very rapid. An earlier embossed type consisting of large roman letters (probably within the same space of a square centimeter) required, on the contrary, a whole series of touch movements and could be read, therefore, only very slowly.

The perceptual method of instruction, supplemented necessarily by manual training and modeling, takes the blind child farther into the objective world. It is wonderful how far the imagination is developed in this way. On the occasion of exhibitions, which are held in connection with the meetings of Blindenlehrerkongresse, I have found such true-to-life models that one could believe that their creator was a seeing person.

If the normal accomplishments are very good they may, with practice, take on a genuine artistic character and may serve a useful purpose. This is true in the case of Hubert Moundri, for example, a blind sculptor in

Litau in Mähren, whose life-like busts, pictures of a hunt, marine pictures and other works have been awarded prizes and compare favorably with those of seeing artists.[1]

Also the delicacy (I mean the intensity) of touch can be trained to quite a remarkable degree. Thus, I am able to read well through cloth or leather gloves, and very well through kid gloves. As a student I had great fun in practicing reading with the toes, and within a short time I was able to keep on the lines with the great toes, and could decipher single words. Today this experiment, once a joke, may have a practical application in the case of a war-blinded individual who also has lost his fingers. I am convinced that he can also attain great tactual achievements with consistent training of the feet.

However, not only the extremities where the sense of touch is strongest, but also the whole surface of the skin can be trained for touch accomplishments. For example, the tongue and lips are in a high degree peculiarly well adapted to tactual sensations. This seems so obvious that it scarcely need be mentioned. I can determine the most delicate sensations with the tongue only, and I know a blind woman who inserts the finest thread in a very narrow-eyed needle by holding both to the tongue. She twists the needle until she feels the thread in its eye, then she sucks in, holding her breath. She answers my question in the negative as to whether she can also feel it with the finger. In another connection I will discuss how the sense of touch is manifested in other parts of the body, and its importance there.

In summarizing what I have just said, I will only add here that the blind, with the help of the sense of touch, can bring everything near to them and can get a correct idea of all that can be produced spacially, even if it is in greatly reduced form. I have blind acquaintances who model life-like busts after stampings on coins, and imitate from representations in relief things which they do not handle at all, as, for example, the Wartburg with sculptures and architectural details. Through such imitations the blind show plainly that they comprehend the object correctly.

Hearing may be considered as the second point of compensation. The blind also depend much on their training and practice. Here, as in the case of the tactual sense, "practice makes perfect." One must *learn* to hear and must be educated to allow no noise to pass by unnoticed and to find a possible explanation for it. Hearing is quite analogous to sight, since many will overlook things which another will not pass by without noticing. Thus he whose hearing is trained and who is accustomed to pay attention to everything will notice noises which another does not hear at all.

How often have I called forth striking impressions in the seeing by my

[1] Compare also the paper of W. Stern about "Künsterliche Plastik eines Blinden." (Artistic Modeling of a Blind Individual) (With illustrations) *Zeitschrift für Angewandte Psychologie 6.* 78-79. 1912.

delicate hearing! I recognize in the noisy streets the clicking of the taximeter at each revolution, a noise which most seeing people have never heard, although it is loud and clear. I recognize vehicles by their peculiar trundle when typical, as, for example, the parcel-post wagon, the furniture van, the ladder wagon, etc. I can even differentiate if a liquid is cold or hot by the marked differences in the noise it makes while being poured. Also, the recognition of people by their walk is an accomplishment of the sense of hearing. Thus, once to my own astonishment, it happened that I recognized immediately a step which I had not heard for three years.

The popular modern rubber heels are naturally the greatest enemies to our ears. They take away completely the differentiation of the steps in the same way that every sound-deadener, such as snow or wet ground, generally makes auditory recognition more difficult. Furthermore, the sound of their own steps has extraordinary meaning for the blind. Rooms which are often entered are recognized by them quite unconsciously through this discernible sound, and any change which modifies the noise is noticed. Thus, I once maintained that in a room into which I came daily, something, or someone perhaps, must be about; and I did not change this notion despite assurances to the contrary. Finally, it was proved that the mischief-maker to my ear was a basket of unironed laundry, the absence of which I also recognized later, even though it was standing under the table when I first noticed it.

These and similar occurrences are close to those phenomena which can be gained only through the sense of touch without the help of the ear. In this connection a lively controversy has grown up and has appeared repeatedly in the literature on this subject. Heller, Hitschmann, Kunz, Truschel, and others have written much regarding this, so I will not differ here from this literature concerning what is popularly known as the "sixth sense." This imaginary "sixth sense" is supposed to furnish the blind individual with sensations which far exceed those of their normal tactual and hearing senses. William Stern presents some worthwhile material on this question based upon his visit to the deaf-blind Helen Keller,[1] which convinces me that the rôle of the tactual sense is greater than that of hearing in compensating for lack of sight. I have made similar observations upon the deaf-blind Hofrat Hugo Ritter von Chlumecky of Brünn. My findings coincide with those of Stern in regard to Helen Keller.

Here is one example only. Hofrat von Chlumecky and I entered a restaurant which was recommended to him as being very good. As we went through the dining room he asked his wife (who understood the manual alphabet) if it were not very empty. This was really the case. In such an instance hearing was quite impossible, hence it must have been due to touch. Similarly, Helen Keller distinguishes a tree which she is passing.

[1] W. Stern: "Helen Keller, Persönliche Eindrucke." *Z. ang. Psychol.* 3, especially pages 328-329.

In a walk which I took with a blind friend in the Berlin Tiergarten, we stopped before an obstruction which blocked the street at the height of about a half-meter from the ground without coming in contact with it. Since there was no sound-reflecting wall, but only a thick pole, the sensation of hearing could not have entered here.

It is idle to speculate where this delicate tactual sensation is located, whether, as is frequently said, it is in the forehead or in the nape of the neck. In my opinion, it cannot be said that there is a special place for it in the body, since numerous experiments have shown its presence in various places. Therefore, it seems that the capacity for the most delicate tactual sensations is distributed over the entire skin. This delicate pressure is experienced sometimes as a partially distinct and partially vague tactual sensation. The air is cut off by some obstacle, wall, tree, etc., and thus some part of the body is reached by a modified pressure and by this means the existence of these obstructions is perceived.

Once I went alone from my compartment in a railway coach to the dining car and sat down on an empty chair in the middle of the car, and a fellow passenger would not believe that I could not see. The whole trick lay in the fact that I passed slowly along the row of tables and felt whether anyone sat next to me or not. This delicate tactual sensation serves the blind person mostly for orientation, and in going out alone he takes advantage of this[1] in order to be warned in time when an "enemy" is near. Such enemies he evades even though they have the small thickness of a hedge or lamp post. It is obvious that in these cases pressure and sound both can be considered, but only when the hearing is stimulated by strong noises while the conscious pressure sensitivity is not working well.

It is known that the blind as well as the seeing depend very much upon conscious sensations; for instance, if I have used my mind intensively, it is a question whether my reconnoitering sense of touch will take a rest or function inadequately, with the result that I will run up against an obstacle, an experience which would never happen if my tactual sense were on the alert. In those cases, however, where hearing is absolutely eliminated, the tactual sense must stand on guard and respond to the slightest pressure. Of this the deaf-blind are the best examples; they react invariably and vigorously. Their touch sensations are distracted by nothing. Thus we have the remarkable performances of Helen Keller and other deaf-blind individuals. Helen Keller *feels* music. William Stern informs us that while he played she placed her arm on the grand piano, and through the vibrations recognized approximately the beat of the measure. Thus she recognized the rhythms of a march. She thought the Chopin funeral march was a cradle song, and a Strauss waltz she identified as a waltz.[2]

[1] Decker, *Auf Vorposten im Lebenskampf.* Stuttgart, Franckh'sche Buchhandlung.
[2] Loc. cit., page 325.

Encouraged by this I tried an experiment on myself. During "a musical evening" I placed my hand on the wooden seat of a chair standing near me, and felt a strong vibration which varied according to the music. Thus, after some practice I could perceive strong pressure waves quite accurately with high violin and piano tones, while quite different waves (I might say weaker and longer ones) could be felt with cello tones. I tried in vain but could not feel the beat of the measure. This made it clear to me that here, also, training can accomplish everything. If necessity demands that the tactual sense be strained to the utmost, then the performances of Helen Keller will not appear too surprising.

The sense of smell, also, assists the blind in their orientation. Thus my blind friend and I, during the walk just described, found a bridge by following the smell of the water until we came to the railing on the shore. I can easily think of cases in which smell as an orientating sense has great meaning. Also, with this sense, practice will result in more than average performances. It is the sum total of the increased abilities of these compensatory senses which is what I have called above "the sixth sense." Certain of these performances are really extraordinary and, to the layman, appear more than wonderful. They gain this impression still further when the blind use their little tricks and aids which they themselves devise to help them in making a good appearance. For example, when I leave my compartment in the railway coach I button the window curtains in a certain way. I have never yet had the experience of not being able to find this landmark upon my return, since the window is hardly ever opened while the train is at full speed.

As a further example I mention the blind individual who frequently takes the same street car trip or the same drive and will orient himself by certain landmarks. Thus he pays attention to the character of the pavement, to street crossings, to the different noises in narrow or broad streets, to the passage under railroad arches. In short, there are so many little aids which the seeing do not think of, that the blind individual really is able to give accurate information as to where he is located. Every blind person occasionally experiences how strongly the proof of this ability affects the seeing. As, for example, I once said to a driver: "You are driving the wrong way—around to the left!" The only thing that the dumbfounded man could say was: "I thought you were blind!"

It is often demonstrated that the blind when in familiar places can direct the seeing. I know many who like myself have a complete mental picture of all streets in Berlin, and in my Breslau I know every corner. The blind do not like to drive, since they can learn to recognize places only by walking through them. Despite its heavy traffic the greater part of London is as well known to me as many a small town, because I always walked around there and thus became well oriented.

I enjoy traveling, and my wife, who is my constant escort, explains

everything to me, and I have such a complete mental image of everything that I can give vivid and accurate pictures in lectures and descriptions. In these cases I always have the illusion that I "see" everything before me. This is probably due to the fact that I had vision up to my sixth year.

I should also like to go into the subject of color imagery of the blind. Just as in the case of images of objects which cannot be handled, this color imagery is naturally dependent upon the kind of blindness. How can those born blind, for example, have an idea of the sun? It is true that a competent teacher may gradually produce correct ideas of such objects, but naturally this is limited. All cannot be represented intelligibly, and this is especially true of color. We have no valid information as to whether or not there is a fading—increasing the longer blindness lasts—and finally a forgetting of the idea of color with those who have become blind.

My blind friend (about whom I have spoken very often) and I both believe, on the basis of experiments, that we can say despite our more than thirty years of being blind that we still have a correct and clear idea of color. Perhaps this is partly the reason why I get great pleasure from visits to museums, the pictures in which no one can explain to me so well as my wife. I have a very clear understanding of the gradation of color and with pictures I also have the impression that I see them before me. I even think I have a correct idea of background and perspective. In this I am aided, no doubt, by a representation in relief of a drawing in perspective which I once felt many years ago.

Those born blind, however, can have no idea of color. For them colors are only words, but where these are used correctly (as in the writings of Helen Keller) memory is a help in that it gives back what has been heard previously, just as memory is always of inestimable value to a blind person. Thus, he often could not explain noises at all if he did not have their analyses in his memory, and if he could not draw inferences from them.

Aside from unimportant limitations the blind person has the possibility, and also the ability, to compensate to a certain degree for his loss of sight so that he can say that the only thing he lacks is absolute unlimited freedom of movement. A rich imagination enables him to picture life correctly and his keen mind—which does not need to feel banished in darkness—takes him into the world of the seeing. There are only a few blind who lament their blindness and wish that they could see. Also, it is a surprising phenomenon that most blind people "see" in their dreams. I once investigated this but my material is so incomplete that it cannot serve as a basis for a special study. In general, however, "seeing" in dreams was confirmed. Unfortunately, I could not find out what is meant by the "seeing" of those born blind.

For myself, however, I can say that I never am guided in my dreams, that I read with the eyes, especially the newspaper, and that I am always very much surprised if someone wants to guide me. I also undertake

climbing mountains and making complicated journeys either alone or as a seeing person in the company of others. I do not know whether this phenomenon is a confirmation of the theory that the dream is a continuation of that which is desired unconsciously[1] during the waking hours, or whether, to those blinded later in life, memory images come in. These memory images are considered very important by William Stern and are thought by him to reach back into earliest childhood.

I should like to support this theory of memory images by the following incidents: In my early childhood, when I saw, the newspaper had great significance for us, and from about my third to sixth year I went to the post office daily, accompanied or later alone, as my father thought the fetching of the newspaper to be very important. Perhaps that is connected with frequent newspaper readings in my dreams. It also is interesting that I see pictures in my dreams as accurately as they have been described to me, and the same is true of a general view of the landscape with which there is almost always a most beautiful sunset. Such a one was the last which I saw shortly before I was totally blinded. It always appears before me when I think of a mountain.

Finally, a word about the sense of beauty of the blind. It is very strong, probably as a further result of their high ethical and aesthetic senses, which in my case are due to the senses of hearing and of touch. The beautiful and the ugly can scarcely be distinguished as clearly by the eye as with hearing and the tactual sense. For the blind, music is a very high aesthetic enjoyment, and the same is true of the most beautiful forms of things and of smooth, polished surfaces.

Symmetry also plays an important rôle. I have often had occasion to observe that the blind have particular predilection for symmetrical representations, and that they, when creating something, always adhere to symmetrical forms: For example, the decoration of books can be limited to the six-dot field mentioned in the discussion of the braille alphabet. This is especially true in the arrangement of title pages in their fundamental forms, and it is amazing to see the detailed sense of beauty which is manifested, and the way in which symmetry always appears as the fundamental principle. This is true also with regard to the statement that the blind may have an idea of the human countenance. There is not the slightest doubt but that the voice presents clues to the appearance of a human being. Generally they come to conclusions on the shape of the mouth, the facial expression, and the body build. Yet here they must have sufficient practice, and even then there is no absolute certainty. It cannot be doubted that the peculiar cadences and characteristics of speech, as well as timbre, permit judgments as to certain definite features, and there are many blind who distinguish these with surprising accuracy.

What is said here makes no pretension to completeness but it does, how-

[1] Freudian theory.

ever, to strict objectivity. I observe myself and other blind people constantly not only in regard to mental ability but also to limitations. Specialists recognize clearly that these limitations are not narrow and, furthermore, the psychologist who is interested in the blind knows that these manifold and far-reaching abilities are suitable to compensate for lack of vision and make possible an harmonious life for the blind.

If the blind man is economically independent he has the feeling of inferiority less than do other individuals with incomplete senses. But as an individual the blind person feels himself superior to the deaf, for example, and also to the deaf and dumb. I have lately taught a deaf-blind girl. When she could read and write and was able to receive other external impressions through the medium of writing, she said to me: "That I cannot see is not quite so bad as that I cannot hear."

The blind individual enters quite completely into his environment. He is able to a very high degree to hear the movements of the actors in the theater. In short, well informed and well guided and accustomed to using the abilities and special characteristics bestowed upon him, the blind man is able to develop into a psychologically high type. The foundation is laid in the institutes where the blind learn to use their fingers. But after that they must train themselves through self-instruction if they are to progress.

One often says it is peculiar that the blind individual is happy. It would be peculiar if he were not happy. He is, through the permanence of the impressions that come to him, so inwardly vital, and is able to be so much for others and for himself, through his harmonious disposition, that it would be ingratitude to Fate if he should complain of his blindness. If his bodily eye is closed, the variegated colors of earthly splendor are no object of display for him; to him light and color reflect no joy. He leads, nevertheless, a useful life. He has within himself sources of joy and "streams of light" because his mind is rich, or may even be over-rich, and this gives the blind man an harmonious and contented nature which finds peace in itself and even dispenses it to others. Thus the blind person, if the numerous treasures are uplifted and purified, walks in outward darkness yet inwardly in shining light.

ARTICLE III

The Blind as Personalities

By Wilhelm Steinberg[1]

The lack of the most important sense influences mental life so profoundly and at the same time in so specific a manner that people have always been interested in blindness and its effects on human life. The people of antiquity in their mental attitudes toward recognized psychical principles, such as the increase in the ability to concentrate when stimuli are decreased, raised these to the level of mystical phenomena. This tendency resulted in the creation of myths, while the Middle Ages attached philosophical observations to blindness, and not until the second half of the nineteenth century did it become a matter of scientific investigation.

The limitations in methods of the generally accepted psychology of this century demanded that one investigate only the mental functions of the blind which lent themselves to experiment. One was concerned principally with mental reactions and confined himself further to their purely quantitative relationships. Such investigations were all the more welcome as they seemed possible without that particular grasp of special mental conditions which the investigators usually did not have; since it was believed possible that sensory processes might be pried loose from the psychical whole without a fundamental modification of it, and that they might be understood completely in their isolation. Aside from the fact that this point of view was wrong and that a mistake was made regarding the sensory performances of the blind, this expression of the psychology of the blind still would not be satisfactory to us because its formulations of the questions do not lead to the distinctive central problem. In these investigations the personalities of the blind remain untouched, and yet only their analysis can teach us to understand the apparently remarkable peripheral functions, in so far as these more or less decreased functions occur within the psychical whole. It is certain that these more or less detached functions are included within the psychical unity.

Modern psychology has never investigated the extent to which the lack of vision affects personality. We must examine the writings of the oldest

[1] The author, blind almost from birth, is a student of philosophy and psychology, and chose as his special field the psychology of blindness. This paper is based on a lecture which he delivered in a seminar in philosophy at Hamburg. Translator's note: Dr. Steinberg is now Professor, Technische Hochschule, Breslau, Germany.

teachers of the blind in order to find detailed accounts of the inner lives of those who do not see. They express their own observations which follow each other in very simple order or, at best, are arranged according to the customary scheme of "Der Vermogenspsychologie." We have here ample material for scientific research, the significance of which is not yet appreciated—a valuable collection of carefully observed single traits; in no case, however, did they make a comprehensive study including all phases of the personality.

If this research is to be done carefully, however, one must not depend upon the observations of the seeing alone, who always run the risk of misinterpreting the signs which they perceive. The blind, therefore, must be consulted more than they have been heretofore. Here one must consider the mental differences between those born blind, the later blinded, and those with some sight. The last named, unfortunately, are very seldom considered, although they are doubly interesting as an intermediate type. The development of the personality, also, should be considered within the scope of such investigations, since personality is not innate but is a growing thing which fundamentally will always continue to develop.

Furthermore, one should not limit himself to the direct expressions of a few blind people, since one single account can never teach us whether any particular experience was determined by the lack of sight or, quite independent of this, by some entirely individual peculiarity as this is conditioned by the characteristics of the individual personality. That which has happened only once is here, as in all cases, of no possible value to a science. While, therefore, differential psychology is to distinguish clearly the relationships between the peculiarities of one and the same individual or a homogeneous group of people, yet under clearly definable conditions the psychology of the blind investigates only typical, specific forms of mental life resulting from the lack of vision, the singular complications of which, together with the manifold psychological factors, make up the personalities of the blind.

It is not the purpose of this brief treatise to cover the inner life of the blind in all its gradations nor to describe the richness of its various manifestations. For this purpose the material which I have collected in the last two years is much too limited. Because I first want to finish other psychological works on the blind, and because the material must be gathered slowly on account of the delicacy of the topic, considerable time must elapse before I can deal with all these questions in a creative way. I shall present here, therefore, only the decisive points of view, in order to furnish directions for further work and, where possible, to induce other blind and those interested in such research to study the personalities of those who do not see.

In the first few weeks of life the blind child obtains information about its surroundings through the ear only. Whereas the eye learns to recognize things by itself, the ear transmits primarily only impressions to which no

objective significance is attached in any way. The exceedingly great variety of auditory stimuli can give the developing consciousness of the average adult information as to the nature of resounding things. This is not true for the infant, however, because of the one-sided relationship of sensation to stimulus which presumes a knowledge regarding the concepts of space and sources of sound. Noises and clangs primarily stimulate only the affective life of the blind which, favored by the decreased multiplicity of outer stimuli, usually manages to hold its governing position in the mental life of the blind child. Because his development, especially during the first few years, is only inadequately guided by perceptions, a danger to the harmonious growth of the personality lies in the unchecked importunity of acoustic impressions.

Normal development can proceed only through systematic perceptual enrichment created by placing in the child's hands numerous objects which attract attention through their characteristic shape and quality of material. Such systematic stimuli are all the more necessary because the blind child's imitative powers are extremely limited. In overwhelming proportion actions are perceptible only to the eye, as movements close to the child are often interrupted by the touching hand. One needs but to consider how much knowledge the seeing child gains through his aimlessly roving eye, how much skill he acquires in playful imitation, in order to comprehend the great mass of planned stimulations which are necessary for the blind child if his development is to keep pace in any way with that of the normal child.

The blind child's training always presents to his parents an especially difficult problem which they generally are incapable of solving. Even when they have enough time to devote themselves to their unfortunate child as completely as his special condition requires, they fail to comprehend that only through activity does one develop mentally. From fear that their darling will get into trouble they will not let him carry on the simplest duties. If they do not have time to give the child adequate attention, he is left alone and often becomes apathetic. However, even when he overcomes these restrictions on his development which result from the limited diversity of his experience, his childhood still lacks very largely that sense of joy which we like to keep in our memory. Only through play with his comrades can he break through his barriers completely, and this is something from which the blind child often is shut out because he risks the danger of getting lost. His handicap makes it impossible for him to do the same things as his seeing playmates, and his awkwardness unavoidably results in his being ridiculed. Such ridiculing has its motive in the same ignorance because of which children torture animals whose expression of pain they do not understand. The result is the same, however, since the blind child is shut out and withdraws entirely from his companions.

Thus, the more he withdraws the more important is his entrance into an institution for the blind. The institution not only brings to him the

knowledge of ways which are adapted to his particular condition, but above all it opens to him a world in which he may feel himself to be a person of full value. This equality of life's conditions unfolds those capacities, the development of which had been stifled by the oppressive superiority of those with all their senses. This is the invaluable significance of the institution for the blind; that it, within its walls, makes the blind child a normal child. Here he is able to learn without meeting obstacles which do not obtain among his comrades. Here he can surrender without limitations to carefree play with his companions and can gather the strength in the happy years of childhood which later he will need so much.

Even on the threshold of childhood, life confronts the blind with double seriousness. At this time the individual, whose glance heretofore has mostly been directed outward, finds a world in himself which seems to him remarkably rich in its individualism. Dormant powers begin to stir and urge him to do things; unlooked-for possibilities for work and enjoyment appear. Even if life is much more modest, the knowledge that the whole world stands open gives a genuine joy to these years. In addition, the blind person discovers himself with trembling respect; he feels a thousand powers awakening in him; but his handicap presents unconquerable obstacles to their development.

The realization that his blindness, as an external limitation, closes many pleasant possibilities to him, makes these years of development the most difficult time in his life. He cannot do justice to his bitterly earnest educational efforts on account of purely technical difficulties. Numerous things which are objects of pure enjoyment to others are unknown to him. Vocations toward which he is inclined are closed to him. He asks himself bitterly why he is living, and the realization of his consciousness of a purpose in life menaces his whole idea of the world. He feels slighted, through no fault of his own, to a degree for which he cannot be compensated, and is puzzled over the goodness of an all-powerful Leader of Destiny. His pessimism is more justified and, therefore, is more dangerous for him than are similar moods which are also customary among the seeing during these years. He often seeks through poetry the deliverance which comes to us from the pushing aside of difficulties. These poems are mostly without artistic value, yet as direct expressions of conditions which are otherwise inaccessible are of great psychological importance.

To the blind person, therefore, who suffers under his handicap, the eye must appear as the most precious, nay as the only true good and the life of the seeing must seem a paradise on earth. His passionate effort will be to take part in this life in so far as his handicap permits, and to live defiantly just as if this defect did not exist at all. He wants to be a seeing person with the seeing, will gladly take upon himself the same duties as they; but, therefore, will also want the same rights. The only difference, viz., that he is blind, fades into the background, since the blind man

himself does not attribute any importance to this. This uncritical striving for unconditional equality originates in the consciousness that he is different from others, and is in reality an escape from himself. It is a desperate attempt to circumvent the adjustment to the "world of light," which makes his difference from others inevitable and to which he tries to put an end.

The form and passionateness of his attempts vary according to the living conditions and the time of blinding. The child born blind recognizes his peculiarity only when others make him feel it. But as soon as he begins to think about himself he will realize the full burden of his handicap. In his developing years he usually is not strong enough to be victorious over the struggle which his exceptional condition imposes upon him so that he can mould his life according to his different needs and capacities for enjoyment. Thus he devotes all his energies, despite everything, to winning entrance to the "world of light," which his imagination makes into a paradise for him. For those blinded late in life this is the home from which a cruel Fate has excluded them. Little wonder then that when they seek to take part in normal activities, in so far as possible, they refuse to admit the existence of their handicap. One with partial sight is in truth a dweller in two worlds. To him the eye still affords various stimuli and enrichments, so that he can relinquish himself to the "sweet illusion" of still being able to participate in the life of the seeing.

When striving uncritically for social equality the blind man puts aside all external things of unmeasurable importance and values it according to the degree to which he is able to make use of it in the same manner as would a seeing person. Above all, the root of all evil—blindness—must be hidden if possible. The blind person thinks to achieve this best by circumscribing its consequences as much as possible. The disagreeable impression created by blindness must be compensated for by overdressing; an effort which not infrequently approximates vanity, especially with girls. Dependence is lessened at any price; even danger is welcomed if it brings one nearer to the much-sought-after goal.

Thus the blind, because of their limited diversity of experience, place great value on actions which are without any intrinsic value and are taken as a matter of course by the seeing. This passionate striving can go so far that the blind person will sacrifice his best, his most real possession—his personality—merely to look the same as others externally since he often mistakes this superficial condition for the basic value. He does not desire to advance in his work beyond the seeing, yet does not want to fall behind nor sacrifice any pleasure. He goes into picture galleries and he thinks he enjoys a picture described to him in the same way, perhaps even more intensively, than does his guide.

He undertakes dangerous wanderings in high mountains and is convinced that he enjoys the perspective view as much as his guide who pains-

takingly describes it to him. He wants to attain for himself acceptable pleasures in the same way as do the seeing. To him social intercourse with a few intimate friends is not enough, even though these friends value personality above everything so that the blind individual himself can contribute something. He yearns for brilliant associates with whom fashion is everything.

Those born blind do not gain real satisfaction from feeling plastic works of art with their fingers, but attempt (as the seeing do) to explain the expressions without having experienced them in their mental life. The gifts which Nature bestows freely on the blind as well as on the seeing are too scant for them, since those with complete senses would hardly climb the mountains if the valley would offer them sufficient pleasures.

These uncritical strivings for absolute equality do not make life happy for the blind, but in the best cases they permit an apparent happiness. Even then this is only possible when they misunderstand their mental peculiarities. Through these misunderstandings the blind ignore their valuable characteristics without being able to lessen the obstacles which are connected with them. It is just in these superficialities that these obstacles make themselves apparent.

Their dependence is not limited to the fact that they cannot go alone on unfamiliar roads, but it is based fundamentally upon their limited opportunity for imitation. They are compelled throughout their entire lives to ask about things and instructions which people with full senses perceive from others. Even the beginning of an anticipated situation is not always recognized immediately by one without vision. Therefore, the blind person in his intercourse with seeing people is often perplexed without their friendly counselling. This inability to control the situation, however, can only actually depress when one forgets that fashionable social intercourse may enrich many lives superficially, but in no case offers any inner value.

Moreover, it is not always easy for those with full senses to show the right attitude toward a blind person, and if he is too sensitive he may lose the friendship of many worthwhile people. First, how shall he dismiss people who wound him with obtrusive pity, or behave in his presence as if he also were deaf? How shall he find a smile for those who are full of praise about his obvious actions, yet have no word of understanding for the fruit of his earnest work? If such distressing events become catastrophes to him, then he is waging a useless struggle against superficiality and retains no strength to overcome the inevitable difficulties and to surrender where he must recognize insuperable limitations.

Nature offers him freely so many joys that he really can save his patient escorts from taking him on dangerous trips. Moreover, what he enjoys through the description of a landscape or a painting are not the things themselves, but moods which the intelligent explainer is able to awaken in him. In the case of those blinded later in life, reproduced visual images

are added which may have a certain similarity to the picture, but which never express its individuality. This individuality usually gives the picture its artistic value and is the real object of enjoyment. The blind person, therefore, finds no joy in paintings but only in inner states which never were released by an artistic object. He may visit galleries if he finds joy in it, but he must recognize the fact that in the descriptions of works of art he cannot attain the real aesthetic attitude. Here, as in all instances where the difference between intention and success is so little observable that he is not conscious of it and its correlates, he goes out into the world of the seeing only in appearance. In fact, the things which are valued by the seeing change under his observation, but what he may gain in inner enrichment through this incongruous manner of approach, he might also win by an emphatic interest in his own field.

The possibility of deluding themselves by their striving allows many blind people to reach the conviction that in reality they lack nothing and that their happiness is undisturbed. Since this joy is founded on illusion, it is an apparent happiness which the adversities of life may destroy at any moment. While they deceive themselves about their limitations, they may mitigate but they cannot subdue their longing.

This uncritical striving for absolute equality has a twofold result: Either the failure of the blind individual is so obvious that his handicap seems doubly difficult to him and takes all the joy out of life, or it is less obvious and therefore permits illusions and an apparent happiness. We certainly do not wish to remonstrate with him on account of either extreme. With respect to happiness his life is not so entirely different but that there are paths leading above and below. He must remain conscious of the fact, however, that we are always dealing with liberties which only a person with character may permit himself. If he forgets that he is only a guest in the seeing world, that his best powers are rooted in another soil, then he denies his peculiarity; and whatever good he may snatch from the life of the seeing, his unavoidable difference makes it only of apparent value to him.

The blind form a particular type. The eye is the most important organ for the comprehension of the external world and at the same time is of striking significance for the whole mental life because perceptions are elementary even in complex mental patterns. Each thought must be expressed so that simultaneously with it there must be a possibility for its vocalization. The sensory substratum of speech which, up to a certain degree of mental development is the bearer of the understanding, consists quite predominantly of optical images. Innumerable processes of different kinds are only perceptible through the eye and, therefore, cannot stimulate and determine the will of the blind. Space shapes and color complexes, in whose individuality aesthetic value lies, can only reach our emotional life through the organ of sight, and even the relationships between men are dependent

upon it to a certain extent. Only he who *sees* the expression of pain about the mouth of the sufferer can offer comfort. Only the eye discerns the friendly smile which bids us welcome.

Thus, blindness is devoid of so many and so worthwhile stimuli for the unity of mental life that one questions the possibility of developing a personality in the unfortunate individual. So long as one believes himself able to characterize the blind exhaustively in terms of the defects which distinguish them, one cannot do them justice. For, thanks to the plasticity of mental life, exceptional performances are based not only on defects but also on reductions in mental abilities. These transformations constitute the positive factors in the mental peculiarity of the blind.

It is most important, in order to make general development at all possible, to produce a compensation for the numberless missing stimuli and those external enrichments. To this end a different attitude toward their sensory activities is needed. It seems obvious, although its significance has not been fully grasped, that the blind person experiences with greater intensity those sensory data which are transmitted to him by his remaining senses. They form the foundations of his mental life and, since most seeing people have very little need of these and, therefore, do not utilize them fully it is difficult for them to conceive of their possibilities. These remaining senses are sufficient to furnish the sensory substratum which is indispensable to the formation of a many-sided, integrated inner life. His intensive attitude toward tactile and acoustic sensory data teaches the blind person to better comprehend their objective meaning and, therefore, to make achievements possible which are not found among the seeing. The purely psychological character of these sensory data forbids our recognizing them as gifts of a penitent Nature, but rather as results of mental effort, and at the same time it helps us to understand how those blinded later in life can become familiar with their new world.

It follows necessarily from our considerations that the blind are special types, because, in the first place, they lack those perceptions which are fundamental to the mental life of a normal person; and in the second place, because they transmit through their remaining senses entirely different impressions for their elementary inner life. These impressions have an equal importance for the formation of their personalities just as visual concepts have for the seeing.

It is just such positive factors which make it possible for the blind person to lead a rich and happy life. He can work and, therefore, he can say that his existence is not worthless either for himself or others. When he is depressed, because often he cannot be active in an occupation commensurate with his ability, then he should think of the many seeing people who are in similar circumstances. The obstacles which he must overcome are greater, but nowadays the blind successfully seek to decrease these difficulties through organized effort. In regard to this, it should not be overlooked

that these obstacles which confront him in all spheres of activity promote the development of the best in him. This explains why we find so many extremes among those who do not see: a weaker will sinks before a difficult task; a strong will develops with the conquering of difficulties.

The imperfect knowledge about distant objects which a blind person gets through his senses forces him to take into account the impressions he receives and their objective importance to a much higher degree than is necessary for the seeing individual. While the latter perceives objects in all their characteristic details, the blind person is informed only by means of hearing and smell.

The necessity for a blind person to reason out for himself that which comes without trouble to those with normal sensory equipment, often makes him self-conscious and forces him to use his intelligence where others turn to their emotions. Although the blind individual's emotions are less obvious they are not poor, as is demonstrated by the fervor with which he enters into friendship and family life. Friendship with seeing people is a very great advantage to him and, therefore, is much desired. The conditions of his existence are so different, however, that only in exceptional cases is this desire fulfilled completely and he finds, after many disappointments, that understanding and sympathy can be obtained only if he finds a wife who shares his life with him in self-sacrificing love. Then a source of great strength and happiness discloses itself to him in his family, for here his defect acts as no barrier to the urge to give something to others.

Music and poetry are true friends to him, which in his most trying hours lift him above his own suffering. His inner life with Nature can develop into religious inspiration, and thus many blind find their God in Nature. He often follows passionately religious discussions and universal aspects of world questions. Here the dividing barrier falls and he is freed from dependence on the senses. If he is able to work out a satisfactory philosophy of life, it will give him strength to carry his faith with dignity during his most trying hours.

The life of the blind is rich despite all limitations; or it can be made rich. In this they are in the same condition as the seeing. Fundamentally, life is what one can make out of it. This effort stamps itself upon them in a special way so that they become conscious of their limitations. The man who does not see understands that he is governed by special conditions and that, therefore, his life must be shaped differently if it is to take these conditions adequately into account. Only when personality is trained under developmental conditions which are determined by Fate, can it acquire true worth.

The uncritical striving for complete equality leads, at the very best, only to an apparent happiness which will bear no serious examination. The blind person should not suppress this longing for the world of the seeing by

telling himself that he really is not missing anything. He must conquer this longing. This he may do in the certainty that his handicap does not represent solely a defect but at the same time it releases in him creative forces which enable him to develop a unique and worthwhile personality. This certainty is in no case innate but must be won through inner conversion.

The personalities of the blind vary in value according to life conditions. Personality development comes most easily to those born blind because they have lived in a world of the blind from the beginning, whereas persons blinded later in life continue with their visual concepts and use the perceptions of their remaining senses only in order to reproduce them. Only gradually do they realize that they no longer can obtain any enrichment from their visual concepts, so that the impressions which hitherto have been ignored have now become vital to them. Only when they are conscious of the formative powers which lie dormant in blindness can they reconcile themselves to the impossibility of living as they did formerly.

With the partially seeing individual the temptation is strong to consider himself as a seeing person and to put entirely too much value on the small part which he still is able to take in the world of the seeing. He will not be spared bitter disillusionment so long as he does not know, or want to know, that although "the world of light" may enrich his life, he owes his peculiar value only to that which he has, independent of the fact that he is a partially seeing man.

Favorable outer circumstances of life do not necessarily make blindnesss less difficult. The average man who must struggle hard for his living by the work of his hands has a consistent goal, and usually a definite form of activity. He is doubly thankful for each modest pleasure which his hours of leisure permit, because he must work doubly hard for it. The blind man for whom money and an extensive education are available regards satisfaction of his physical needs as a matter of course, and his life requirements really begin where those of the simpler man are satisfied. It may be added that difficulties increase with the somewhat greater scope of his occupation, and that it is often impossible for him to find a sphere of activity commensurate with his gifts and skills.

It is often difficult for the feminine blind to be content with their lot. Since the province of being a wife and mother is practically closed to them, they must govern their emotions with reason, suppress their desires, and renounce pretensions to the life which others may enter with impunity. In addition, they often can find no inner interest for their remaining activities, while blind men very often find complete satisfaction in their fields of endeavor.

With the clever blind the saying is very popular: "We are not blind; we only cannot see." There is naturally no objection to this saying if it springs from the wish to do away with the painful feeling that the word *blind* usually produces when it is used even figuratively by the seeing.

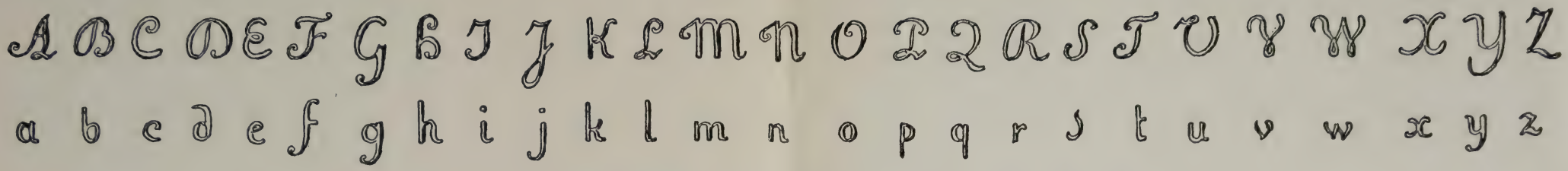
This saying, however, usually connotes more than this; it expresses the thought that although the blind may have a minor defect, otherwise they are like the seeing, have the same duties and, therefore, may make similar demands.

To these people it cannot be emphasized enough that the blind person is just as far from being a seeing person who does not see, as is the seeing man a blind person who sees. The lack of the most important sense creates such special conditions that the whole mental life must be distinctive. If the blind person makes allowance for his handicap in his attitude toward life, he finds a smile for the many small mischances (which he unavoidably meets) which raises him above them. He then wins strength of character to conquer difficulties and to make renunciations where he must recognize his limitation. His life will then become a blessing for himself and for others.

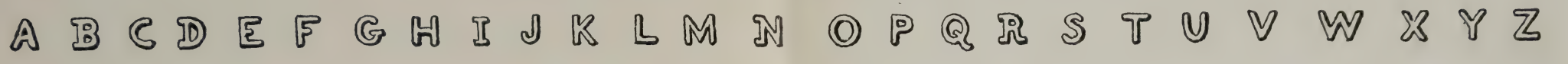
He should not shut himself out of the world of the seeing but must accept thankfully what it offers him, and thus he may create out of it many riches for himself. He lives in the midst of normal people and in many things he must adjust himself to them. He can, and he should, not only learn outward conduct from them, but they can also give him much that is worth while. His existence is interwoven much too closely with theirs for him to be able to avoid the transgression of his limitations.

Without harm, also, he may indulge occasionally in comforting illusions. Nobody is without weaknesses—and illusions are weaknesses—but they become dangerous to the genuineness of his personality if he makes the value of his life dependent upon them. In the wall which separates the blind from the seeing, love and truth may cut many gaps but it can never be broken down completely. It will not help the blind person to delude himself concerning this fact. He must become aware of his peculiarity and its inherent value, and thus learn to look upon the obstacles which a cruel Fate has placed upon him merely as limitations upon the free activity of his personality.

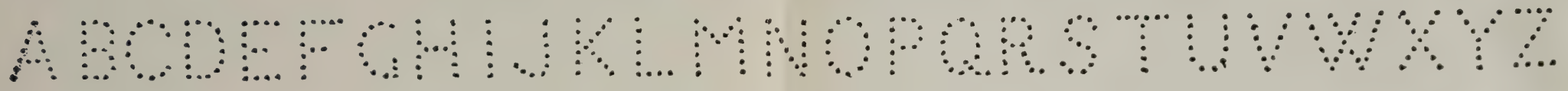
FIGURE I



1. Ältester Blindendruck in Kursivschrift von W. Haüy. Seit 1786.

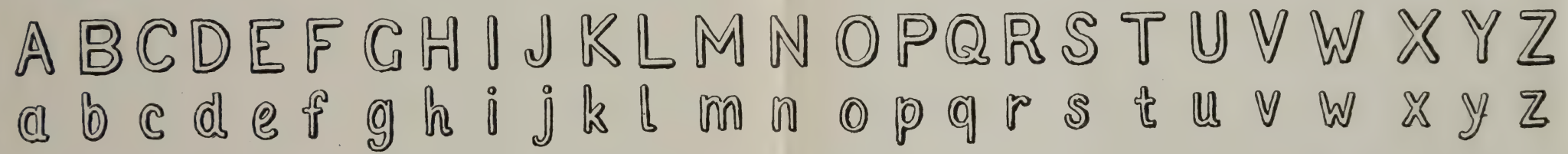


2. Älterer Liniendruck in Antiqua. F. Lesueur seit 1806. P. Dufeau seit 1840.



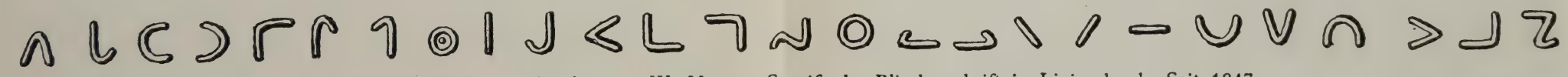
3. Stachelschrift in Antiqua von J. W. Klein. Seit 1809.

4. Perldruck in Antiqua. Stuttgart. Seit 1840.



5. Späterer Antiquadruck. Wien. Seit 1840.

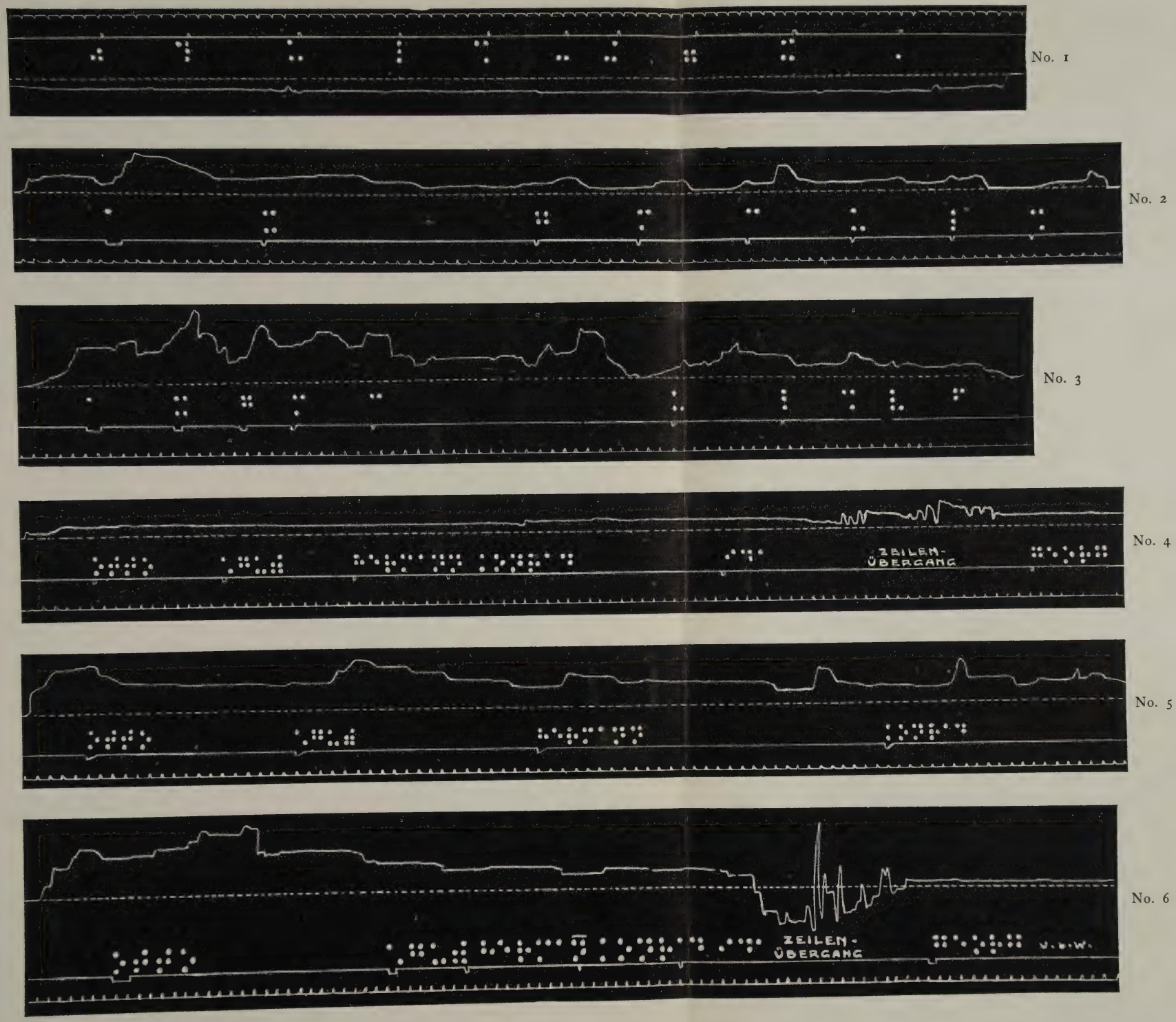
6. Runenschrift von J. Gall. Stark veränderte Antiqua. Seit 1833.



7. Blindenschrift von W. Moon. Spezifische Blindenschrift in Liniendruck. Seit 1847.

8. Punktschrift von L. Braille. Spezifische Blindenschrift in Punktdruck. Seit 1821.

FIGURE II



HV1626 c. 1
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Bürklen, Karl
Touch reading of the blind.
1932.

Date Due

HV1626 c. 1
B
Bürklen, Karl
AUTHOR
Touch reading of the blind.
TITLE
1932.

DATE DUE	BORROWER'S NAME